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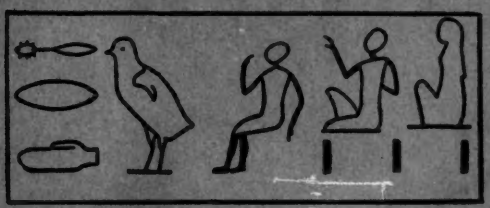
CHILD DEVELOPMENT



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ASPECTS OF LANGUAGE DEVELOPMENT: THE GROWTH OF LOQUACITY AND VOCABULARY[1]

ARTHUR T. JERSILD AND RUTH RITZMAN[2]

This study deals with the growth of talkativeness and vocabulary during preschool years. The subjects were 88 two- to five-year-old children, above average in intelligence, enrolled in the nursery schools of the Child Development Institute during the period from 1928 to 1934. In the case of 73 children, the data include a verbatim record of the language used by the child during three mornings in the nursery school, representing approximately nine hours; each of the remaining 15 children was observed during two mornings, or for a period of about six hours.

These language records, which include what amounts to a rather lengthy booklet for each child, have been compiled under the auspices of the Child Development Institute. The data they contain may be approached from several angles. This study deals primarily with amount of talking and size of vocabulary as related to each other and to such factors as age, sex and intelligence. An earlier study by Fisher,[3] based upon data available at the time for seventy-two of the present 88 children, dealt mainly with an analysis of sentence structure and with the egocentricity and sociability of children as revealed by their language.[4] In an earlier study by Caille[5] a number of the records were analyzed in an investigation of resistant behavior; and the records were used also as a supplement to Murphy's study of sympathy,[6] and they are being analyzed from other points of view in a study, now in progress, by Peterson of imaginative behavior and in a study by Fite and Jersild of children's adjustments in the nursery school.[7]

Nature of the Data. The methods used in gathering the data have been described by Fisher, and need only be indicated briefly here. During each of the different days devoted to a given child, the child was followed by a person who was experienced both as a stenographer and as an observer of children. The child was observed from the time he entered school in the morning until he had finished his lunch and was ready for his afternoon nap. All vocalizations or remarks made during this time were recorded exactly as they sounded to the observer. The record also included an account of the situation in which each item of language occurred, of the language or behavior of playmates or of teachers, and of other events transpiring in the child's environment. An effort was made to complete all three of the records for each child within a single week. In seventy-one per cent of the cases, all records were completed within a week or less, but in the remaining instances, more than a week (and as

[1]This study was conducted under the auspices of the Child Development Institute. The authors are grateful to Dr. Lois Hayden Meek, Director, for aid in conducting this study, and to Dr. Saul B. Sells for statistical assistance. They acknowledge also the aid of workers, supplied by the Works Progress Administration, under the classification Project Number 65-97-295, Sub-project 10, in tabulating the data.

[2]From Teachers College, Columbia University.

[3]Fisher, M. S. Language patterns of preschool children. Child Development Monographs, No. 15, 1934, 88 pp. Bureau of Publications, Teachers College, Columbia University.

[4]This paper refers to only a limited number of studies of language. For an excellent review of earlier literature, the reader is referred to McCarthy, D. Language development. Chapter IX in A Handbook of Child Psychology (C. Murchison, editor), pp. 278-315. Worcester, Mass.: Clark University Press, 1931.

[5]Caille, R. K. Resistant behavior of preschool children. Child Development Monographs, No. 11, 1933, 142 pp. Bureau of Publications, Teachers College, Columbia University.

[6]Murphy, L. B., Social Behavior and Child Personality. New York: Columbia University, 1937, 344 pp.

[7]Jersild, A. T. and Fite, M. D. The influence of nursery school experience on children's social adjustments. (Unpublished) For brief summary, see Jersild, A. T. and Fite, M. D. Children's social adjustments in nursery school. J. Exper. Educ., December, 1937, pp. 161-166.

much as a month) transpired between the first and final record.

These stenographic records were subsequently typed in a three column arrangement: one column showed the elapse of time, another gave an account of the general situation in which the child was located, and of speech and behavior of other children and adults in the situation, and the third reproduced, verbatim, the speech of the subject.

Subjects. Table 1 shows the distribution of the subjects according to age, sex, and I.Q. Several I.Q. ratings were available for most of the children, but in each case the rating that was used was the one obtained in the mental test nearest in date to the time when the child's language was being recorded.

It can be seen from Table 1 that the children, with an average I.Q. of 132, are quite above average in intelligence, and therefore are more representative of bright children than of children of normal intelligence. Most of the children likewise were above average in socio-economic status. Although the I.Q.'s are on a high level, it still is possible to study the data in terms of chronological age and mental age, especially since the various age groups (with the exception of the two subjects in the range from 60 to 65 months) are quite similar in average I.Q.

Method of Tabulation. This report is based mainly on two tallies, (1) a count of the total number of words spoken by the child, and (2) a count of the total number of different words used. In making the first-mentioned count, a tally of one was allowed for each word, whether that word was used once

TABLE 1

DISTRIBUTION OF CASES BY AGE, SEX AND I.Q.*

Age Range to Nearest Month	Boys N	Boys Mean IQ	Girls N	Girls Mean IQ	All N	All Mean IQ	S.D.
18-23	1	125			1	125	
24-29	3	116	8	136	11	130	15.2
30-35	11	125	9	139	20	131	17.03
24-35	14	123	17	137	31	131	16.4
36-41	10	125	12	136	22	131	16.1
42-47	13	133	13	136	26	135	14.1
36-47	23	130	25	136	48	133	15.2
48-53	3	130	2	128	5	129	18.8
54-59	1	138	1	155	2	147	8.5
48-59	4	132	3	138	7	139	19.1
60-65	1	116			1	116	
66-71							
60-71	1	116			1	116	
Total	43	127	45	137	88	132	15.88

* IQ's are based on the Kuhlmann-Binet scale, except in the case of six children, distributed among the various age groups, whose scores were based on the Minnesota Preschool scale.

or many times. For example, if a subject said "no" ten times, "yes" three times, and "boy" once, the score would be (1) 14 for number of words spoken, and (2) 3 for number of different words used. Totals were computed for each morning's record as well as for the entire series of records available in the case of a given child. The value for total number of words spoken during three mornings represented simply a cumulative total of the records of the separate days, but the count of the total number of different words used during two or three mornings represented again a tally of one only for each word, whether it occurred once or often in one or all of the separate records.

In counting the number of different words used, no proper nouns were tallied; plural forms were not tallied unless the singular had not been used; variants of verbs, adjectives and pronouns were not counted as separate words unless they were irregular or if the roots of the word were changed; childish forms of the same word were counted as different words (i.e., mother, mammy); two or more words representing a single concept counted as one word (kiddiekar); childish designations were counted ("choo-choo" for train); incomprehensible words were not counted; slang expressions were counted; contractions of verbs and negatives (can't, won't) were counted as one word (except as noted elsewhere in this paper); each part of a verbal combination was scored as a separate word (e.g., "have been playing" represents three items). In the count of total number of words spoken, a tally of one was given to each word, or each grammatical form of a word, each time it recurred (with the exception that contractions were counted as one word).

Internal Consistency of the Data. To measure the consistency of the data and thereby to obtain some indication of the adequacy of the sampling represented by the available language records, correlations were computed between scores on different days. The correlation between total number of words spoken the first and the second day, in the case of 88 children, was .77 $\pm$ .03; the corresponding coefficient for total number of different words used was .82 $\pm$ .03. Similar correlations between the records of the second and the third, and the first and the third days likewise yielded coefficients above .70 or .80. With the factor of age partialled out, the coefficients obtained when the scores of the first and second days combined were correlated with the scores of the third day were .79 for number of words spoken and .74 for number of different words used.

RESULTS

Changes with Age. The increase in sheer quantity of speech is perhaps the most obvious indication of the rapid development of language during the early years of childhood. The tables that follow indicate the rate of this increase with age, and compare the change in amount of talking with increases in size of vocabulary. Table 2, which is based on all the subjects in the study, shows the number of words spoken and the number of different words used per three-hour period at tri-monthly, half-yearly and yearly chronological levels. Table 3 shows corresponding results when children are classed according to mental age.

Table 2 shows a rapid increase with age in amount of talking and in number of different words used.

Irregularities in the tri-monthly averages and in the averages for children over four years old, all of which include smaller groups of children, indicate that individual differences may be so pronounced as to overshadow age trends.[8]

[8]The subject of individual differences will be touched upon again at a later point. It may be said here, incidentally, that conditions which might cause a fluctuation within a single child's behavior from day to day were controlled as far as possible while the data were being collected. No records were taken if a child's condition seemed abnormal in any way, as manifested by apparent unusual fatigue, crying spells, temper tantrums, the effects of recent illness, etc.

TABLE 2

DEVELOPMENT OF VERBOSITY AND VOCABULARY AS RELATED TO CHRONOLOGICAL AGE

Mean and median number of words spoken and of different words used per three hours by 88 two- to five-year-old children[a]

Age in Months	No. of Children	No. of 3 Hr. Records	No. of Words Spoken (T)			No. of Different Words Used (D)			Ratio of D to T[e]		
			Range	Mean	Median	Range	Mean	Median	Range	Mean	Median
Tri-monthly											
21-23	1	3	-[a]	202	202	-	51	51	-	.262	.262
24-26	4	12[b]	241- 434	336	333	60-112	79	73	.243-.297	.270	.267
27-29	7	20	236- 729	439	431	75-142	102	82	.200-.368	.256	.252
30-32	11	32	99-1370	691	682	36-273	139	131	.136-.418	.236	.212
33-35	9	26	299-1967	861	753	104-298	169	171	.201-.352	.233	.231
36-38	11	32	793-1620	1238	1112	137-275	272	213	.155-.288	.205	.186
39-41	11	33	396-1990	1354	1465	111-394	235	264	.201-.300	.211	.199
42-44	12	35	322-2723	1518	1502	117-552	284	282	.159-.400	.217	.194
45-47	14	38	1370-3084	1990	1803	259-800	332	325	.102-.230	.179	.178
48-50	3	8	322-1905	1450	1865	102-344	242	279	.184-.316	.232	.195
51-53	2	4	714-1384	1049[c]	1049	164-285	225[c]	225	.209-.246	.228	.228
54-56	1	2	-	1426	1426	-	337	337	-	.236	.236
57-59	1	2	-	1978	1978	-	359	359	-	.183	.183
60-62	1	2	-	599	599	-	107	107	-	.190	.190
Half-Yearly[d]											
24-29	11	32	236- 729	402	424	60-142	94	81	.200-.368	.261	.252
30-35	20	58	99-1967	763	718	32-298	153	161	.136-.418	.234	.228
36-41	22	65	396-1990	1296	1348	111-394	254	264	.155-.300	.208	.199
42-47	26	73	332-3084	1772	1761	117-552	309	311	.102-.400	.197	.183
48-53	5	12	322-1905	1238[c]	1310	102-344	235[c]	222	.184-.316	.230	.209
54-59	2	4	1426-1978	1702[c]	1702	337-359	248	348	.183-.236	.210	.220
Yearly[d]											
24-35	31	90	99-1967	636	512	36-298	131	114	.136-.418	.244	.234
36-47	48	138	332-3084	1533	1483	111-552	276	273	.102-.400	.202	.190
48-59	7	16	322-1978	1371[c]	1426	102-359	267[c]	286	.183-.316	.224	.209

(a) The score used for each child in computing the mean and the median represented the average score obtained by the child in two or three three-hour records

(b) See (a). The number of three-hour records varies according to the number of children who were observed only two forenoons instead of three. At 24-26 months, the value of 12 for "No. of Records" means that all four children were observed three times; at 27-29 months, the value 20, means that six children were observed three times and one child only twice.

(c) Two of the children aged 48-53 months had IQ's considerably below the average for the group as a whole; moreover, some of the children above 48 months in age were enrolled in kindergartens.

(d) Two children, one below two years and another above five years, are omitted.

(e) The ratio of number of different words used (e.g., size of vocabulary used during the period of observation) to total number of words spoken (representing a tally for each word and each repetition of a word) was computed for each daily record in the case of each child. The average of each child's daily ratios was used, in turn, in computing group means and medians. Mean ratios, therefore, do not necessarily correspond to values that would be obtained simply by computing ratios between group means.

The large variation among individual children is shown even more clearly in the range of the scores at various age levels. One of the children at 27-29 months, for example, has a score of 729 words spoken, as compared with a score of only 322 for one of the children in the group aged 48-50 months; again, a child at 24-26 months scores 112 in number of different words used during three hours as compared with a score of 102 for one of the children at 48-50 months.

According to Table 3, there is a sharp rise in number of words spoken and number of different words used at half-yearly chronological age intervals from 24 months to 47 months; but the sharpest acceleration appears from 24 to 41 months. In Table 4, it appears that there is a marked increase in verbosity and vocabulary with mental age from 27 months to 59 months, with

TABLE 3

DEVELOPMENT OF VERBOSITY AND VOCABULARY AS RELATED TO MENTAL AGE

Mean and median number of words spoken and different words used per three hours by 88 two- to five-year-old children, ranging from 27 to 85 months in mental age.

Mental Age in Months	No. of Children	No. of Words Spoken (T) Range	Mean	Median	No. of Different Words Used. (D) Range	Mean	Median
Tri-monthly							
27-29	3	202-299	248	243	51-105	72	60
30-32	4	99-512	334	362	36-112	75	77
33-35	3	236-434	304	241	70- 82	76	75
36-38	8	312-1282	620	483	57-195	115	115
39-41	3	715-1620	1235	1370	185-273	235	247
42-44	7	212-1780	980	979	88-284	185	189
45-47	11	332-1606	787	682	117-264	167	171
48-50	4	631-1564	1024	951	164-273	209	200
51-53	8	793-2586	1461	1472	194-298	247	250
54-56	8	322-2162	1444	1453	102-344	268	283
57-59	8	1436-3084	2066	1853	273-533	365	318
60-62	6	1315-2212	1842	2042	264-394	328	239
63-65	4	396-2289	1300	1257	111-385	254	260
66-68	3	1038-1843	1520	1679	210-349	282	286
69-71	2	599-1370	985	985	107-262	185	185
72-74	2	1384-2664	2024	2024	285-376	331	331
75-77	1	-	1737	-	-	329	-
78-80	0	-	-	-	-	-	-
81-83	2	714-1978	1346	1346	164-359	262	262
84-86	1	-	1426	-	-	337	-
Half-yearly							
24-29	3	202-229	248	243	51-105	72	60
30-35	7	99-512	321	199	36-112	75	75
36-41	11	312-1620	788	715	57-273	148	132
42-47	18	212-1780	862	646	88-284	174	172
48-53	12	613-2586	1315	1247	164-298	234	236
54-59	16	322-3084	1755	1713	102-552	312	295
60-65	10	396-2289	1625	1683	111-394	298	318
66-71	5	599-1843	1306	1370	107-349	243	262
72-77	3	1384-2664	1928	1737	285-376	330	329
78-83	2	714-1978	1346	1346	164-359	262	262
84-86	1	-	1426	-	-	337	-
Yearly							
24-35	10	99-512	299	271	36-112	74	75
36-47	29	212-1780	834	729	57-284	164	168
48-59	28	322-3084	1566	1483	102-552	279	274
60-71	15	396-2289	1519	1375	107-394	280	288
72-83	5	714-2664	1695	1737	164-376	303	329

the sharpest rise occurring at the mental age range from 36 to 53 months. The fact that there is little or no increase in the upper age levels, within the present narrow range (after the fourth year of chronological age, and after the fifth year of mental age) is due, in part, to the fact that some of the older children were enrolled in kindergartens, but the results show a deceleration in the rate of increase even when these children are left out of the computations (See Table 6). The trend would be more impressive if the subjects included a larger number of older children. However, various minor indications in the tables (the range of individual scores and the medians at tri-monthly and half-yearly age levels) are quite consistent with the trends noted above, and limited as internal evidence of this kind may be, it suggests that the trends might be confirmed if a larger number of older subjects had been studied. Even if this is granted, however, there remains the question as to what these trends mean. The slowing of the rate of language development in the older children may not reflect a "true" developmental phenomenon so much as it reflects specific environmental influences. It is possible that the nursery school environment is relatively more stimulating to the younger than to the older children, and (although adequate proof is lacking) that the deceleration shown by the older children would not be nearly so marked if the school environment were relatively as stimulating to the older as to the younger child.[9]

COMPARISONS BETWEEN SELECTED GROUPS

In an attempt to isolate, as far as possible, the factor of age in relation to language development, separate tabulations were made of the data of forty-four selected children, by way of a supplement to the tabulations based on all the subjects. An effort was made to select comparable groups of children at half-yearly age levels. The eleven children available at the 24-29 level were

TABLE 4

DISTRIBUTION OF AGE, SEX, AND I.Q. OF SELECTED GROUPS OF SUBJECTS

Age in Months	N	Boys	Girls	Ave. C.A.	Ave. I.Q.	No. of 3-hour records available per child	
						3 hr.	2 hr.
24-29	11	3	8	26.8	129.7 (12.9)*	10	1
30-35	11	6	5	32.5	133.4 (7.8)	10	1
36-41	11	4	7	38.6	130.9 (10.7)	10	1
42-47	11	5	6	44.6	131.9 (10.7)	10	1

*The values in parentnesis represent average deviations.

[9]It is obvious that tallies simply of number of words spoken and number of different words used measure only limited aspects of language development. However, certain other indices tended to conform to the pattern noted above. An independent tabulation of the use of the past tense likewise indicated a tendency toward less rapid progress among the older children of nursery school age. There was a sharp increase in the use of the past tense at half-yearly levels from 24-29 months to 36-41 months, but children aged 42-47 months scored no higher than did children in the 36-41 months range.

used as a starting point. Groups of eleven children at succeeding half-yearly levels were chosen to resemble each other, as nearly as could be approximated, along the following lines: an average age corresponding to the mid-point of the interval which each group represents and a similar distribution of ages around that mid-point in the various groups; similarity in average I.Q. and in spread of I.Q. scores; similarity in number of boys and girls; similarity in number of language records available per child. These conditions were met as nearly as possible, but a perfect match could not, of course, be obtained. The greatest dissimilarity between the groups occurs in the number of boys and girls, but rather than sacrifice subjects, this shortcoming was allowed. Due to the small number of subjects above the age of four years, the "matched" subjects were limited to four groups of two- and three-year-old children. These groups are described in Table 4. Within each group, records covering three days were available for ten children, while records for two days were available for the eleventh child.

The records of these selected groups are summarized in Table 5. From the point of view of total amount of language spoken per unit of time, it appears from Table 5 that:

There is somewhat more than a four-fold increase in number of words spoken during the age interval from the first half of the second year to the last half of the third year (or, in terms of averages as indicated in Table 4, from the 27th to the 45th month). Somewhat more than a four-fold increase during this interval is also shown for the larger groups of "unmatched" children represented in Table 2. In terms of yearly averages, three-year-olds show approximately a three-fold increase over two-year-olds.

According to Table 5, the biggest spurt in amount of talking and in size of active vocabulary comes during the interval from 36 to 41 months (inclusive). This trend is not consistently confirmed, however, by the results based on all subjects (Table 2). Both Tables 4 and 2 show that the rate of increase in amount of talking is considerably more rapid up to the age of three and a half years than during the ensuing half year (comparisons with later half-yearly levels are not legitimate by reason of the fact that two of the older children were below the group-average in intelligence, and the further fact that some of them attended kindergarten).

The age trends in Table 2 and 5 are complicated by the fact that there is a larger proportion of girls at the younger levels. It has been found in earlier studies, and also in the present study (see a later section of this report) that girls somewhat excel boys in early language development. The age trends here noted are, however, somewhat too marked to be explained solely on the basis of sex differences.

On the basis of results obtained for all subjects within the age range from 24 to 48 months, the average increase in amount of talking at each half-yearly age level as compared with the preceding half-year was 66 per cent. The corresponding average half-yearly increase in number of different words used was 50 per cent. On the basis of the records of a smaller number of subjects in the age range from 24 to 48 months, as represented in Table 5, the average increase in number of words spoken at a given half-yearly level as compared with the preceding half-year was 68 per cent; and the corresponding average increase in number of different words used was 57 per cent. The increase at half-yearly levels is, however, decidedly larger (ranging from two- to seven-fold larger in the various comparisons) at the 30-35 months interval and at the 36-41 months interval (as compared with the respective preceding half-year levels) than at the 42-47 months interval. On the basis of the present results, there is a distinct deceleration in the language gains of bright children in the nursery school situation at the age of three and a half years. The falling off in the gains at this point is larger than would be accounted for by the relative proportions of boys and girls at the various half-yearly levels.

TABLE 5

DEVELOPMENT OF VERBOSITY AND VOCABULARY AS RELATED TO CHRONOLOGICAL AGE

(1) Number of words spoken, (2) number of different words used, and ratio of (2) to (1) in data of "matched" groups of children at various age levels[a]

		Per 3-Hour Period									Per 6-9 Hours		
		T: No. words spoken			D: No. different words used			R: Ratio D/T[c]			R		
	N	Mean	SD[d]	Diff. / σ Diff.[f]	Mean	S.D.[e]	Diff. / σ Diff.	Mean	S.D.	Diff. / σ Diff.	Mean	S.D.	Diff. / σ Diff.
Half-yearly													
24-29	11	407	208	-	94	41	-	.261	.098	-	.176	.067	-
30-35	11	688	384	2.42	137	70	2.23	.220	.086	1.84	.150	.071	1.33
36-41	11	1457	644	4.04	257	94	4.96	.197	.079	.86	.119	.048	1.36
42-47	11	2011	892	2.09	340	147	2.19	.186	.078	.45	.104	.035	1.47
Yearly													
24-35	22	547	309	-	116	54	-	.241	.076	-	.163	.058	-
36-47	22	1734	710	7.02	298	109	6.90	.191	.064	2.27	.111	.033	3.52
		T.			D.			R.			R.		
		Median	Q	Diff. / P.E.Diff.	Median	Q	Diff. / P.E.Diff.	Median	Q	Diff. / P.E.Diff.	Median	Q	Diff. / P.E.Diff.
Half-yearly													
24-29	11	424	131	-	81	25	-	.252	.082	-	.169	.029	-
30-35	11	646	190	2.21	149	45	4.14	.212	.021	2.51	.130	.032	1.95
36-41	11	1478	380	5.18	264	27	5.62	.177	.035	1.56	.120	.021	.50
42-47	11	1843	644	1.63	292	54	.88	.176	.020	.05	.107	.008	1.30
Yearly													
24-35	22	499	218	-	108	41	-	.230	.030	-	.150	.033	-
36-47	22	1586	331	7.61	280	31	7.67	.177	.021	2.90	.109	.015	3.33

(a) See Table 4 for description of subjects.
(b) Represents three 3-hour records in the case of 10 children at each half-yearly interval and two three-hour records in the eleventh case.
(c) Mean (and median) ratios are based upon averages, separately computed for each child.
(d) Represents a tally of one only for a given word in a child's data, whether the word occurred once or several times in one or more of the child's records.
(e) S.D.'s were computed on the basis of a denominator of N-1. The number of cases is obviously too small to yield valid S.D.'s, but these are reported, none the less, for what they may be worth.
(f) In computing the value of $\Delta/\sigma\Delta$ (and $\Delta/P.E.\Delta$) in each half-yearly comparison, the correlation between the scores of children in constituent "matched" groups was taken into account, statistically. The coefficients in question were all positive and ranged from .35 to .77, with a median of .50. In comparisons between yearly age levels, these correlations were not taken into account.

INCREASE IN VOCABULARY AS COMPARED WITH INCREASE IN VERBOSITY

From the point of view of number of different words used, or size of active vocabulary within the periods covered by the study, the results in Table 5 indicate that:

The increase in active vocabulary from the first half of the second year to the second half of the third year (or, in terms of average ages according to Table 3, from 26.8 months to 44.6 months) is somewhat above three-fold.

The three-fold gain during this period in number of different words used is uniformly lower than the four- to five-fold gain exhibited in total number of words spoken. In other words, there is a larger gain with age in verbosity than in size of vocabulary. This trend also appears at the separate half-yearly age levels from two to four years, both in the unselected and the "matched" groups.

The relation just noted between verbosity and size of vocabulary is shown more precisely in the D/T ratios in Table 5. At the 24-29 months level, for example, the ratio of number of different words used (D) to total number of words spoken (T) per three hours is .261. This means, roughly, that every fourth word is a "new" word, or (again, very roughly) that each word that is used is repeated, on the average, four times. At the 41-47 months level, the ratio falls to .186, which, on the same basis, means that the vocabulary used by the average child during three hours is about one-fifth as large as the volume of words spoken.[10]

The tendency of younger children to use single-word sentences, might, in some respects, tend to increase the ratio, but, on the other hand, the younger child's tendency to repeat single words and phrases would operate in the other direction.

The tendency of younger children to use a higher proportion of different words in relation to total number of words spoken appears again in the results for two or three mornings combined. At the 24-29 months level, for example, the average number of different words used per morning represented 45 per cent of the words used by the child during all mornings combined. At this age, the children spoke 94 words per three hours, on the average; the average per child during six to nine hours was 185. At the 41-47 months level, the corresponding percentage is 58. The difference here is not large, but the trend is consistent from one half-yearly age level to the next. The findings here suggest that an older child gives a more representative sampling of the size of his vocabulary within a three-hour period than does a younger child (within the age range, sampling, and environment of the present study).

Representativeness of One Day's Sampling as Related to Age. This tendency also appears when the data are examined in terms of daily records. In the case of the children in the "matched" groups, a count was made of the different words used by each child during the first day of observation, of the "new" words added on the second day which were not spoken on the first day, and of the words used on the third day which were not used either on the first or second days. Following is a summary of the results. The values represent percentages, based upon the total number of different words used during three days. The denominator in computing the percentages is the number of different words spoken during the total period of three days.

[10] Lists showing the frequency of various words were examined to discover whether certain word forms that inevitably occur frequently during conversation were having a differential effect on the ratios at different age levels. The words spoken most frequently in all groups were various forms of the first personal pronoun, and various forms of the verb "to be." Moreover, "you" showed increasing frequency with age. But when the tally of these forms was subtracted from the total, the differences between the ratios at different age levels were substantially unchanged.

Age in Months	24-29	30-35	36-41	42-47	All
N*	10	11	11	10	42**
Per cent of words appearing in the first day's records	48	52	58	57	53.8
Per cent of "new" words added the second day	27.5	26	25	24	25.6
Per cent of "new" words added the third day	24.5	22	17	19	20.6

A single day of observation (as compared with three days) reflects relatively a somewhat larger representation of the active vocabulary of older children than of younger children.

The ratios set forth above for all subjects combined, regardless of age differences, are of some interest. It appears that a single three-hour record per child in the age range under consideration will yield about half as many different words as will be found at the end of three three-hour records.

CORRELATIONS WITH AGE AND INTELLIGENCE

When the language scores of the 88 children were correlated with mental age, chronological age, and I.Q., the following coefficients were obtained:***

	No. of words spoken	No. of different words used
Chronological age	.58	.63
Mental age	.59	.67
I.Q.	.23	.30

These coefficients give practically equal weight to the factors of chronological and mental age with a slight indication that there is a higher relationship between intelligence and the size of a child's vocabulary than between intelligence and a child's verbosity. The results in Tables 3 and 4 suggest, however, that the factor of mental age may be more important, relatively, at the younger than at the older age levels. This is borne out also when correlations are computed between mental age and language scores at separate six-months (chronological) intervals. The correlation between mental age and total number of words spoken at the chronological range from 22 to 29 months is .70; corresponding coefficients at succeeding intervals (30-35 months, 36-41, and 42-47) are, respectively, .50, .09 and .24. (These coefficients represent the following number of children: 12, 20, 22, and 26.) The correlations between mental age and number of different words used at the corresponding intervals are: .61, .63, .26, and .42.

In spite of the irregularities exhibited by these coefficients, they definitely suggest that there is a closer relationship between mental age and language development in the case of the younger than in the case of the older children.

The same trend appears when correlations between I.Q. and language scores are computed at successive half-yearly age levels. The correlation between I.Q. and number of words spoken at 22 to 29 months is .67; at 30-

*The summary omits children for whom there were only two three-hour records. In two of the groups, three records were available for all the children. In earlier tables, the record for the third day of one child in each of these groups was discarded to provide a similar number of records in each of the 'matched' groups.

**Rough computations indicate that substantially the same values would emerge if the records of all 88 children in the study were analyzed.

***The correlation between number of words spoken per three hours and number of different words used (on the basis of results for all 88 children), with the factor of age held constant, was .58.

TABLE 8

COMPARISONS BETWEEN BOYS AND GIRLS IN VERBOSITY AND VOCABULARY AS RELATED TO CHRONOLOGICAL AGE[a]

Age in Months	No. of Children		No. of Words Spoken Per 3 Hours (T)						No. of Different Words Used Per 3 Hours (D)						Ratio: D/T					
			Range		Mean		Median		Range		Mean		Median		Range		Mean		Median	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Trimonthly																				
24-26[b]	1	3	-	241-434	243	363	243	424	-	70-112	60	86	60	75	-	.243-.297	.247	.278	.247	.293
27-29	2	5	299-727	236-622	514	421	514	451	75-142	61-132	109	100	109	82	.203-.252	.200-.333	.228	.268	.228	.259
30-32	6	5	99-1370	212-1029	751	630	747	682	36-273	88-211	128	151	105	173	.136-.359	.212-.418	.209	.267	.186	.254
33-35	5	4	299-1370	494-1967	741	986	783	746	105-218	104-298	166	173	171	148	.218-.352	.143-.201	.253	.209	.231	.223
36-38	6	5	849-1620	793-1605	1292	1174	1024	1008	184-247	137-275	207	229	194	258	.155-.239	.165-.238	.199	.213	.196	.186
39-41	4	7	396-1478	1139-1990	889	1619	842	1470	111-240	219-394	183	290	200	284	.162-.300	.148-.201	.255	.185	.276	.198
42-44	5	7	631-2093	332-2723	1372	1622	1436	1567	164-343	117-552	258	303	276	238	.170-.307	.159-.400	.222	.214	.210	.181
45-47	6	6	1370-2586	1375-3084	1860	2137	1750	2066	259-381	273-500	307	364	304	363	.102-.207	.164-.230	.172	.188	.178	.183
48-50	2	1	322-1865	-	1094	1905	1094	1905	102-344	-	223	279	223	279	.184-.316	-	.250	.195	.250	.195
51-53	1	1	-	-	714	1384	714	1384	-	-	184	285	164	285	-	-	.246	.209	.246	.209
Half-yearly																				
24-29[c]	3	8	243-729	236-622	424	389	299	428	60-142	70-132	93	94	75	82	.303-.252	.200-.252	.234	.272	.247	.262
30-35	11	9	99-1370	212-1967	746	784	753	632	36-273	88-298	145	161	149	173	.136-.359	.148-.418	.229	.241	.226	.234
36-41	10	12	396-1620	793-1990	1031	1434	978	1468	111-247	137-394	199	265	194	265	.155-.300	.148-.289	.221	.197	.217	.191
42-47	13	13	631-2586	332-3084	1684	1860	1679	1843	164-381	117-552	288	331	292	321	.102-.307	.159-.400	.191	.202	.184	.181
48-53[d]	3	2	322-1865	1384-1905	967	1645	714	1645	102-344	279-285	203	282	164	282	.184-.316	.195-.209	.249	.202	.246	.202
Yearly[d]																				
24-35	14	17	99-1370	212-1967	677[e]	605	686	494	36-273	70-298	134	129	137	112	.136-.359	.148-.418	.250	.256	.228	.243
36-47[e]	23	25	396-2586	332-3084	1401	1656	1435	1564	111-381	117-552	249	299	247	284	.102-.307	.148-.400	.204	.199	.190	.184
48-59	4	3	322-1978	1384-1905	1220	1572	1290	1426	102-359	279-337	242	300	254	285	.183-.316	.195-.256	.232	.213	.216[f]	.209

(a) The means and medians are computed on the basis described in connection with Table 2.

(b) Age levels in which only one sex is represented are omitted from the table.

(c) Note that the values for girls at the yearly level of 24 to 35 months are distorted by the disproportionately large number of girls at the half-yearly level of 24 to 29 months.

(d) Average IQ's at yearly age levels, of boys and girls as shown in Table 1 respectively, follow: 2 years, 123 and 137; three years, 130 and 136; four years, 132 and 138. Average IQ's at smaller age intervals are shown in Table 1.

(e) The 48-59 level includes one girl within the range 54-56, and one boy within the range 57-59, who are omitted from the half-yearly comparisons.
Δ/Δd values, for average number of words spoken and number of different words used are, respectively, .44 and .16 in favor of the boys at two years and 1.36 and 1.67 in favor of the girls at three years.

(f) The average ratio of all boys combined (including two not represented in the table) is .216; all girls, .222; corresponding medians are .203 and .201.

35 months, .46; at 36-41, .13; at 42-47, .19. The corresponding, respective correlations between I.Q. and number of different words used is .56, .57, .22, and .32. (At 48 to 62 months, representing only 8 subjects, the coefficients are .26 and .40.)

The foregoing points to a consistent positive correlation between I.Q. and language development (and this in spite of the fact that the range of I.Q. is limited, with no score below 100) as measured by the present indices, but it appears that the correlation is higher before the age of three years than it is thereafter.

COMPARISONS BETWEEN BOYS AND GIRLS

In several studies, girls have appeared to have an advantage over boys in early language development. By reason of the attention which this topic has received, the present data were also tabulated from the point of view of comparisons between the sexes. Table 6 shows these comparisons, based upon all the subjects in the study, representing 41 boys and 45 girls. The scores for total number of words spoken and total number of different words used are computed in terms of averages per three hours.

According to the results in Table 6, girls excel boys in number of words spoken and number of different words used in most of the comparisons at half-yearly age levels. In the case of ratio of total number of words spoken to number of different words used, the differences are not consistent or large.

The comparisons in Table 6, it will be observed, are based upon uneven numbers, without regard to differences in the ages and I.Q.'s of the boys and girls in the various groups. In order to eliminate these differences, as far as possible, another series of comparisons was made, based only upon an equal number of boys and girls, matched with respect to C.A., M.A. and I.Q. The table showing these comparisons, representing 34 pairs, including 9, 22, and 3 pairs respectively at two, three and four years, is not reproduced here, since it showed substantially the same trends as are revealed in Table 6: boys again surpassed girls at the two-year level, girls surpassed boys at the three- and four-year levels, and in the results for all ages combined. In the combined records, the boys showed an average of 1306 words spoken, as compared with 1379 for the girls; according to statistical computation, the chances are only 47 in a hundred that there is a true difference. The respective averages for the number of different words used were 235 and 260, again favoring the girls; the chances of a true difference were 76 in a hundred. Sex differences in the verbosity-vocabulary ratios in this restricted group were not consistent with those shown in Table 6; boys showed a higher ratio at three and four years, girls at two years, manifesting a trend that is neither substantial nor statistically reliable.

In summary, then, the present findings with regard to sex differences in verbosity and vocabulary indicate that girls tend quite consistently to surpass the boys, but not to a degree that is statistically significant. In the matter of size of active vocabulary in relation to loquacity, there are no conspicuous or reliable differences.

ILLUSTRATIVE RECORDS OF INDIVIDUAL CHILDREN

The foregoing tables indicate that there are large individual differences among children, merely from the quantitative point of view. The differences exhibited simply in terms of amount of language spoken and number of different words used are no more impressive than the differences which appear

Charles. Age 22 months. (Youngest in group)

TIME	PLACE	SITUATION	CHILD'S LANGUAGE
9:10	Roof	**Sees Mary White**	Mary White
		Goes to slide and slides. Goes up again and slides. Jimmy is crying. C. goes over to him and watches. T (Teacher) comes over for C. to give him his orange juice.	No, No.
		Runs back to slide. T. comes over and takes his hand.	No, no.
		Goes to slide and sits on top. Looks at D. who is swinging.	Hello, Dickie. Hello, Dickie. (Too low for D. to hear.)
		Slides. Then goes over to James and Jack, who are on the engine. Watches them, then returns to slide. Slides. Goes up again. Mabel goes by with truck.	Hello, Mabel. Hello, Mabel.
		He slides. Runs to wooden horse. Climbs up. Looks at children.	Hello, Mary, hello, Mabel.
		Returns to slide and slides. Goes up again and slides. Goes up again. Mabel, on swing, says, "Bobby Burr. Bobby Burr."	Bobby Burr. Bobby Burr. Bobby Burr.
9:25		Slides. Goes up again. T: Charles, let's go get our orange juice.	

Henry. Age 58 months.

(Note that this excerpt covers only 9 minutes, while the above represents 15 minutes).

9:05	Roof	Henry and Jerome go to large group of boxes. Henry gets up onto large box. Billy gets onto box with him.	No, no, Billy. This isn't for you. Jerome, here's Billy.
		Jerome: No, you cannot.	
		T: gives Jerome rope.	Oh, thank you very much. Give it to the captain. Throw it up to the captain. I'll do it for you. You will make a big knot. Give it to me.
		Jerome gives him the rope. T. takes small boxes down from top of box.	Don't take the big box down, will you?
		T: You see, there are so many up here and they are so high up they might hurt the children.	
		Jerome gets rope. Let's tie it.	You get off here and I'll tie it.
		Jerome: What?	You get off here and I'll tie that.
		Jerome: You tie the galloping ponies.	
		They come down from box.	Here, pony. Come here, pony. Come over here. Where our barn is going to be. Come where I'm going. Come over here.
		O. steps on rope accidentally	
		They run to jungle gym.	Hey, you. Stop that.
		Jerome: What are you going to do?	I'm going to tie it so to your cage.
		Jerome: Why?	Because I don't want you to walk away. Come here, horsie.
		Jerome: No, sir. I'm going to run away.	

0:15

Jerome runs away.

John holds rope and Henry runs after Jerome.

He goes back to John.

John: Yes.

Henry puts rope around John. Jerome comes over.

He ties rope to jungle gym. The knot slips and John runs away.

Henry ties it again.

Bell: What are you doing?

Bell: Why?

Bell: Why don't you want him to run away?

Bell: Well, I'll tie a very hard knot then he can't get away.

John goes away and Jerome comes over. Jerome: Henry, you tie Bell. Tie Bell.

0:14 Take rope to ben John is playing in.

John, will you hold this rope while I catch Jerome? 0:58

Hey, John, catch Jerome. I'm going to catch him in the rope.

I'm going to catch him in the rope.

John, you be the pony. 10:00

You are not playing. John is going to be the pony, so don't you care. You aren't going to play. Now the pony can't get any further away.

Pony. (Laughs.)

I'm going to do it another way now. 0:23

I'm going to tie John in here. 0:24

Because he's my pony. I don't want him to run away.

Because I don't want him to get lost again.

All right. Where will we tie him? I'll tie it over here.

Hey, John. Don't do that. What do you mean by doing that? Johnny, are you making another boat like you made yesterday?

He pushes her away.

She watches children there. Returns to other side. Goes to swing:

I want to swing on that swing. I want the doll swing. I want the doll swing. I want the doll swing.

She swings.

Swing. I get a swing. I get a swing. Swing. Swing.

She leaves swing. Gets wheelbarrow and pushes it around. Goes to elevator. T. is there with group of children.

I want to go in. I want to go in.

Rachel. Age 34 months. I.Q. 139

Average words spoken per three hours, 241

Comes in and is examined.

Looks at T. My jacket?

T: What is it? My jacket?

T: We are going to take it off.

She takes her mittens off. My mittens. My mittens. My jacket? My jacket?

She unzips it. T: You can take it off, can't you? We will take off your hat. My hat.

She points to T's pin. What is this? What is this? What's this?

T. talks to someone, does not answer her. T. takes her things off and she walks away.

T: Rachel, you put your galoshes away. What?

T: You put your galoshes away. She picks up her galoshes. Takes them to her locker. Finds rubbers there that do not belong to her. Rubbers. Rubbers.

T: Don't they belong to you? Put your galoshes in there. My galoshes.

She puts her galoshes in her locker.

She gets carriage. Wheels it around. T. takes her to bathroom. She goes to toilet. Panels in T's hands.

T: Beads. Do you like beads? What's this?
T picks up Rachel's dress. My dress.

T: That's a very pretty dress. My dress.

T: Yes, Rachel's pretty dress.

The two ten-minute excerpts which follow offer a comparison between two of the younger children (both 34 months old) of similar I.Q., who differ considerably in total number of words spoken.

Meg. Age 34 months. I.Q. 139 0:32 Playroom

Average number of words spoken per three hours: 494.

She goes to swing. 0:50	I want to swing too. I want to swing too. I want to swing too. I want to swing.
She gets on swing and swings.	Swing. Swing. Swing.
She leaves swing. Takes carriage away from Francie. 0:52	I want to take the carriage. I want to take the carriage.
She wheels it into the cupboard.	I want to put the doll and carriage away. I want to put the doll and carriage away.
Helen has kiddy-kar in cupboard.	Kiddie-kar coming. Carriage is coming. Carriage is coming. I put the carriage away.
Helen closes cupboard doors. Meg laughs.	I want to see something. Leave the doors open. Leave the doors open.
They open the doors. Helen takes the carriage.	Leave it in.
Helen: No, no. (She takes it out.)	
Meg comes out and looks around. 0:56	Choo choo train. Choo choo train. Choo choo.
She goes to other side of hall. Jim is there. She looks at him. 0:57	Jim.

when the language records are studied in terms of the style and content of the language of different children. By way of illustrating some of the differences, representative portions of the records of different children are reproduced below.

The two excerpts, on the preceding page, give a comparison between the youngest and one of the oldest children in the study. The contrast is marked, not only from the point of view of quantity of language per unit of time, but also from the point of view of the content and complexity of the language pattern.

SUMMARY AND DISCUSSION

This study deals with the development of loquacity and vocabulary in the language of preschool children of high average intelligence. The subjects were 88 two- to five-year-old children, enrolled in nursery schools and kindergartens. The average IQ of the subjects was 132.

The data consist of stenographic, verbatim records of the children's language during the school day from the time when the children arrived in the morning until the time for the afternoon nap. Each child's language was recorded during two or three days. Seventy-three of the children were observed during three days, or about nine hours, and the remaining fifteen were observed during two days, or about six hours, representing a total of 249 separate, daily records for all subjects combined.

The main treatment of the data for the purposes of the present study consisted of a tally of the total number of words spoken (loquacity) and the number of different words used (vocabulary) by each child. Correlations between children's scores on separate days gave reliability coefficients ranging above .70.

As might be expected, the results show a substantial increase with chronological and mental age in amount of talking and in size of vocabulary. When the factor of IQ is taken into consideration, the results, when treated according to chronological age levels, agree substantially with the results according to mental age.

The gain at each half-yearly level as compared with the preceding half-year in the age range from 24 to 48 months was approximately 66 per cent in number of words spoken and 50 per cent in number of different words used. The gains were decidedly larger at half-yearly intervals from 24 to 41 months than at the succeeding half-year (in various comparisons, the former gains range from 50 to 129 per cent, the latter from 11 to 37 per cent). According to the present results, there is a distinct deceleration in the language gains, as measured by the present methods, of bright children in the nursery school situation at the age of three and a half years. The present data do not indicate to what extent that is a normal developmental trend and to what extent it may be due to various environmental factors.

The increase with age in amount of talking is larger than the increase in the vocabulary used while talking. Children aged 42-47 months spoke between four and five times as much per three hours as did children aged 24-29 months, but they used only a little more than three times as many <u>different</u> words as did the younger children.

Corresponding to the foregoing, there was a decline with age in the ratio of amount of talking to size of vocabulary used. At 24-29 months, the ratio of number of different words used to number of words spoken per three hours (including repetitions of the same word) was approximately four to one; at 42-47 months the ratio was about five to one. Roughly speaking, each fourth word spoken at 24-29 months was a "new" word, while at 42-47 months only every fifth word was "new." This trend appeared in spite of the greater

tendency of younger children to repeat single words many times in succession. (These results were not materially altered when certain words that frequently recur in conversation at all age levels, such as various forms of the verb to be and of the first personal pronoun, were eliminated from the computations.)

The results further show, in keeping with the foregoing, that a given time sampling of the spontaneous talk of a younger child in the free nursery school situation will be less representative of the child's vocabulary than will a sampling of similar duration in the case of an older child. This appeared from a tabulation of all the different words appearing in the records during three days in the case of each of ten selected children at the four half-yearly age levels from 24 to 47 months. At 24-29 months, 48 per cent of the child's three-day vocabulary appeared the first day; 27.5 per cent of the words were added the second day, and 24.5 per cent the third day. At later half-yearly levels, a larger percentage of the child's three-day vocabulary appeared in the first day's record (57 per cent at 42-47 months) and, correspondingly, each new day brought relatively fewer "new" words into the record (24 and 19 per cent, respectively, on the second and third day in the case of children aged 42-47 months). The differences between successive half-yearly levels are not large, but their general trend is noteworthy.

In a majority of comparisons at half-yearly age levels, the girls surpassed the boys both in loquacity and in vocabulary. Comparisons between boys and girls matched with respect to age and IQ likewise showed the girls to be in the lead, but the differences were not statistically reliable. In the matter of the ratio of size of vocabulary to total amount of talking, the sexes were substantially similar.

The correlation between chronological age and number of words spoken per three hours was .58; between C.A. and number of different words used, .63, The corresponding correlations with mental age were .59 and .67; and with I.Q. .23 and .30.

The correlations with I.Q. may be considered relatively high in view of the fact that all children were above average in intelligence. Judging from these coefficients, and the trends in the language scores as related to mental age, considerably higher coefficients might be expected if measurements were made of a more representative sampling of the child population at large.

The results indicate that there is a considerably higher relationship between language development (as here measured) and I.Q. (as measured by standard tests) among younger than among older children within the nursery school range. The correlation between mental age and number of words spoken by children aged (chronologically) 24-29 months was .70; at succeeding half-yearly levels the corresponding respective coefficients were .50, .09, and .24. In the case of number of different words used, the correlations with mental age were likewise higher at two years than at three (the respective half-yearly coefficients from 24 to 48 months were .61, .63, .26, and .42). Similarly, the younger children showed a considerably higher correlation between I.Q. and language scores than did the older ones: the correlation between I.Q. and number of words used was .67 at 24-29 months; .46 at 30-35 months; .13 at 42-47 months; and .26 at 48-62 months (representing only 8 subjects). The corresponding coefficients in the case of number of different words used were .56, .57, .22, .32, and .40.

The findings with regard to a higher relationship between intelligence and language development in the case of the younger than in the case of the older children of nursery school age are open to several interpretations. At first glance, it appears that the effects of intelligence are more prominent during the period when language is still rapidly in the process of being established as a means of social intercourse between children than during later periods of refinement and expansion. On the other hand, the relationship may not represent

a true developmental phenomenon but may be merely an artifact; it may be that facility in the understanding and use of language is relatively more helpful in earning a high score on mental tests for younger than for older children. Again, even if this reservation is waived, it is possible that the trends would be different if aspects of language other than simply the volume of speech and size of vocabulary were treated. Further, the trends may be a function of the conditions under which the data were obtained: it is possible that the findings would be different if the children had been studied during their entire day, rather than only during their stay in nursery school, or if the data had dealt not simply with spontaneous speech but with language precipitated by questioning and conversation under experimental conditions. Further research is needed to answer these questions.

It can be seen that some of the results reviewed above have certain practical implications. From a research point of view, it would appear that some practical significance attaches to the fact that a three-hour sampling of the active vocabulary of children during their free play is relatively more adequate, as compared with a nine-hour sampling, in the case of the younger than in the case of older children within the nursery school range. Stated differently, a larger proportion of "new" data accrued from each added three-hour period of observation (within the same week, or, in the most extreme instances, within the same month) in the case of younger than in the case of older children. The present results are in keeping with findings in other studies, particularly in the area of mental measurement, which indicate that it usually is more time-consuming and difficult to obtain reliable measurements of younger than of older children.

Moreover, according to the present results, it is conceivable that the scores obtained in different samplings may be low and yet show a consistent distribution, thereby yielding a high reliability coefficient, in the usual statistical sense, and still fail to tap underlying abilities or characteristics in the case of younger children as adequately as do higher scores, in a similar time sampling, in the case of older children.

Two of the findings, namely, that there is a distinct decline in the rate of language gains at about three and half years, and that scores show a higher correlation with IQ and mental age in the case of younger than in the case of older children, suggest certain educational implications. To be sure, these trends may be due to a variety of factors, but they do suggest, among other things, that the conventional nursery school situation may be relatively more stimulating, and relatively more of a challenge, to younger than to older bright children within the customary nursery school age range. Further study would be needed to show whether this hypothesis is correct. Even if it were proved to be correct, there would still be the question as to whether anything should be done about it. In addition, it should be emphasized that the subjects who display this trend are above average in intelligence. Even with these reservations, however, the findings are not without significance from a practical point of view, especially when considered in conjunction with somewhat similar trends that are emerging from studies of other aspects of the development of nursery school children. Preliminary results in a study by Gutteridge,[11] dealing with the motor activities of preschool children, indicate that the conventional nursery school environment is relatively less stimulating, in the motor sphere, to younger than to older pupils. The findings indicate that a large proportion of children will have gained substantial mastery of the skills involved in the use of several of the standard items of equipment long before the end of their stay in the conventional nursery school. These findings suggest the need for a revision and

[11] Gutteridge, Mary. The development of motor skill in preschool children. (Tentative title) Unpublished. 1938. Teachers College, Columbia University.

extension of the motor aspects of the curriculum for older nursery school children, just as the present findings tentatively suggest that intellectual aspects of the curriculum might profitably be revised and augmented in order to give the child an optimum opportunity to enjoy the use of his growing powers. Obviously, the findings underlying this suggestion need to be confirmed and need to be supplemented by research that will yield concrete recommendations.

SOME RELATIONSHIPS BETWEEN MUSCULAR PROCESSES AND PERSONALITY AND THEIR FACTORIAL ANALYSIS

M. A. WENGER[1]

A popular topic for psychological discussion, but a relatively unexplored field of research, has been the often suggested relationship between muscular processes and temperament. Since temperament is so generally regarded as a component of personality, the latter term is most frequently employed as the postulated correlate. Many years ago James (11) spoke of the "explosive" and "obstructed" types of personality, of which the former was supposedly associated with hyperactivity of the skeletal musculature and the later with hypoactivity. Later Davenport (3) wrote of hyperkinesis and hypokinesis and certain apparent relationships to temperament. Downey (4) also assumed similar relationships and attempted to measure individual differences in motor activities. In addition to these observations by psychologists it is almost commonplace in lay thought to relate differences in personality to individual differences in muscular activity, muscular tension, or neuro-muscular energy. Witness such descriptive terms as "bundle of nerves", "restless", "jittery", "fidgety", "jumpy", "nervous", "tense", and "energetic", which are used not only to describe personalities but which are commonly related among themselves and to other manifestations of personal-social behavior differences. Not the most uncommon relative, but perhaps the most obscure, is emotional tension.

The experimental literature bearing directly upon the problem is not large. In 1928 Johnson (12) cited data suggesting a relationship between overt muscular tension and individual differences in temperament. Duffy (5, 6), following her work, found that for a group of nursery-school children tension upon a hand dynamometer during a task correlated 0.52 with ratings of excitability made by teachers and physicians. Freeman and Katzoff (7) employed the same measure of tension and correlated the rank score with ranks of fifty college subjects' own ratings of their annoyance to six irritating conditions introduced during the task of reading. A coefficient of 0.49 was found. Lee (13) studied the relationship of adult and child scores on the Woodworth-Mathews questionnaire to measures of standing steadiness and knee-jerk amplitude (supposedly an indirect measure of muscular tension). She found no evidence of relation to the latter, and only slight relationship to the former. Seham (21), however, believes his data from normal children and those with functional disorders show the latter to be less steady on the Whipple test; and he shows in another study (22) that motor restlessness is slightly more prevalent in the "abnormal" subjects. A comprehensive study which bears indirectly upon the problem is that of Darrow and Heath (2). From 23 measures of physiological reaction to stimuli and from responses to neurotic and introversion-extroversion questionnaires, physiological syndromes and personality constellations were developed. While none of the resulting correlation coefficients was large, the authors conclude that these groups of variables may be arranged simultaneously in two continuously overlapping series, both characterized by something akin to hypo-reactivity at one extreme and hyper-reactivity at the other. Perhaps most insistent concerning the relationship between muscular processes and emotional unstability is Jacobson (10). He reports marked success in treating chronic cases of neurasthenia (which he terms neuromuscular hypertension) with his technique of progressive relaxation.

The present paper approaches this general problem from a slightly different avenue. Recently the writer (25) submitted a criticism of Pavlov's (19) concept of internal inhibition. It was argued that much of the behavior which

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Pavlov seeks to explain in terms of internal inhibition may more simply be related to muscular processes per se. It was claimed that

(a) Decrement in muscular tension usually will be accompanied by a general decrement in response;
(b) Increment in muscular tension usually will be accompanied by a general increment in response;
(c) The inhibition of a conditioned response may occur without the accompaniment of muscular relaxation and therefore without the phenomenon of general response decrement; and
(d) When muscular relaxation accompanies the inhibition of a conditioned response, decrement in response will be generalized, and the total process must be regarded as two-fold.

With these premises, and their corollaries, one may rephrase many of Pavlov's statements involving the explanatory concept of internal inhibition. This is possible because throughout the experimental work in his laboratory the highly controlled experimental conditions were such as to induce muscular relaxation when no reinforcing agent was used. Thus in most of his work involving extinction of conditioned responses the experimental decrement is combined and confused with the generalized decrement in response associated with reduced muscular tension.

Among Pavlov's many keen observations were some of particular interest concerning the personalities of his experimental subjects. Following the old humoral classification, he speaks of the sanguine and the choleric, as contrasted with the melancholic and the phlegmatic. The former two are classified as excitable animals, while the latter fall at the opposite extreme and are referred to as inhibitable -- those in whom inhibition predominates. Although he does not speak in terms of a normal curve, it is quite clear that he regards these descriptions as extremes of a distribution. The excitable animals are those who are

> "...extremely vivacious, always sniffing at everything, gazing at everything intently, and reacting quickly to the minutest sounds...They can never be made to keep quiet either by orders or by a mild physical punishment." (19, p. 285)

He continues to say that great care to vary the stimuli and environment must be utilized with this kind of dog, and that under that type of regime they make excellent subjects, but the stability of their negative reflexes is never excellent.

The other kind of dog manifests excessive or moderate tendency to inhibition. In every new and slightly unfamiliar set of surroundings such animals are restrained in their movements. They are in general submissive in appearance. They cower and cringe. In such animals the conditioned reflexes, especially the inhibitory ones, remain extremely stable and regular.

During the establishment of a progressively longer delayed response, Pavlov says,

> "The dog with a predominant tendency to inhibition mastered the problem of the longer delay straight ahead and without any nervous disturbances; the dog with a predominant tendency to excitation reacted to the problem is quite a different manner. It began to enter into a state of general excitation, and with a further prolongation of the delay, ...became quite crazy, unceasingly and violently moving all parts of its body, howling, barking, squealing intolerably." (19, p.294)

Now if the concept of "internal inhibition" be dropped, what becomes of the inhibitable animal, and where does the excitable animal fit into the scheme? In the first place, according to the previous analysis, (25), drowsiness and

sleep in the experimental stand are the result of a reduction in muscular tension. In the second place, from the experimental work on muscular tension, relatively greater magnitude and speed of response are known to be associated with increased muscle tension. In the third place, by the previous analysis, consistency or stability of response would be associated with more or less stable muscular tension. Pavlov's "excitable" animals might then be described as those with relatively higher and unstable muscular tension levels.

We have then an hypothesis educed from Pavlov's chance observations on individual differences and from a translation of his concept of internal inhibition. Whether Pavlov did or did not imply continuity in the excitation-inhibition classification he employed, we shall follow the trend of thought away from dichotomies or types of personalities or temperaments and think in terms of continnua. We shall tentatively infer also that individual differences observed in dogs will manifest themselves in higher animals. The hypothesis may then be stated:

> Characteristic levels of muscular tension are related to various forms of personal behavior, and tend to vary continuously in the higher animal forms.

From principles (a and b) cited above we know that decrement of muscular tension within the individual usually will be accompanied by a general decrement in response, and conversely, that increment in muscular tension within the individual will usually be accompanied by a general increment in response. Here decrement or increment of response refers to magnitude, speed, and presumably frequency of response. We may infer that the same relations will hold for the group; then --

> 1) Those individuals with relatively low levels of muscular tension will tend to manifest smaller magnitude, speed, and frequency of response than those individuals with relatively high levels of muscular tension.

The corollary follows:

> 2) Characteristic levels of overt muscular activity are related to various forms of personal behavior, and tend to vary continuously in the higher animal forms.

We have then the logical basis for Pavlov's description of his animals of easy excitation as lively and vivacious, and of his animals of strong inhibition as quiet and phlegmatic. Furthermore, in view of this corollary, which assumes a relationship between muscular tension and muscular activity, we have a ready means of investigating differences of personal be havior in their relationship to muscular tension.

From these two premises we can formally develop some of Pavlov's observations. He says that inhibitory conditioned reflexes in these (excitable) animals are unstable. (19, p. 289) Rephrasing, we may state,

> 3) There is a positive relationship between muscular tension or muscular activity and unstability of certain learned responses.

Further, since unstability of response is characteristic of emotional behavior,

> 4) There is a positive relationship between muscular tension or muscular activity and emotional behavior.

Pavlov again states (19, p.288) that excitable animals are in most cases aggressive. Restated,

> 5) There is a positive relationship between muscular tension or muscular activity and aggressiveness.

In comparing the behavior of his two types of experimental subjects in a frustrating situation Pavlov claims (19, p.294) that excitable animals become quite irritable. Restated,

> 6) There is a positive relationship between muscular tension

or muscular activity and irritability.

These deductions present a picture of interrelation between muscular processes and certain aspects of temperament or personality which are in accord with the literature already cited. Specifically, they lead to the following conclusion:

> Measures of muscular tension, overt muscular activity, unstability of response, emotional behavior, irritability, and aggressiveness, when obtained from the same population, will be positively intercorrelated.

The remainder of this paper deals with preliminary experimentation concerning the tenability of this conclusion.

The subjects of the experiment were seven resident boys of the Orthogenic School ranging in chronological age from 10/0 to 14/1 years, in mental age from 8/2 to 15/4 years, as determined by the Stanford-Binet scale, and in I.Q. from 81 to 128. They offered a wide variety of behavior problems. Only one, a former cretin, had continued medication during the seven month experimental period, and because of this factor his data have not been included in the present analysis.

The postulated relationships involve the following variables:

(a) muscular tension
(b) overt muscular activity - (speed, magnitude, and frequency of response)
(c) stability of response
(d) emotional behavior
(e) aggressiveness
(f) irritability

The measurement of muscular tension, not standardized and offering many difficulties, was attempted by several indirect techniques. Apparatus for a direct measure in terms of action potentials was not available. Pressure on a hand dynamometer during responses to the Woodrow-Lowell (26) revision of the Kent-Rosanoff word list failed to distinguish between the subjects and the data have not been used. Two measures of electrical skin resistance were employed. Wenger and Irwin (24) have shown that individual apparent skin resistance of the palmar surfaces increases as the skeletal musculature is relaxed, and that it decreases as muscular tension occurs. These results have been corroborated by Freeman and Simpson (8). On the assumption that individual variations will hold true for the group, absolute skin resistance is assumed to vary inversely with individual differences in muscular tension.

The data on skin resistance include measurements made during three to eight ten-minute periods per subject.[2] The subjects were seated with the instructions to remain as quiet as possible. The neutral electrode was a zinc plate attached to the ulnar surface of the left forearm. It was coated with Cambridge electrode jelly to minimize the resistance of the surface it covered. The active electrode, also zinc, was attached to the left palm. The electrolyte was a paste of kaolin and 0.9 zinc sulphate solution. The mean of the initial readings in ohms constitute measure Number 30 of Table 1. Variable Number 31 is the mean in ohms of readings at minute intervals read from the photographic record as described by Darrow (1).

Another measure related closely to muscular tension is represented as Number 32 of Table 1, the per cent rise in skin resistance. Since skin resistance increases as muscular relaxation occurs, the number of minutes in which rise of resistance occurred is a measure of the number of minutes during which muscular relaxation took place. Therefore by comparing each minute reading with the previous measurement and tabulating it as a rise or fall, the per cent of

[2]The skin resistance measurements were made with the Darrow Behavior Research Photopolygraph (1). The author is indebted to Dr. Helen Koch of the University of Chicago for the loan of this apparatus.

minutes during which relaxation took place may be determined. The variable may be regarded as a time sampling measure of muscular relaxation in an experimental situation.

One other variable is included which is presumed to be an indirect measure of muscular tension. During determinations of basal metabolic rate (which appear as variable Number 29, and which were included because of their possible relationship to several of the variables under consideration) it was noticed that individuals who appeared to experience most difficulty in relaxation manifested extremely variable respiration curves. On the other hand the individuals who relaxed easily and maintained that state manifested stable and rhythmical curves of respiration. It was believed, therefore, that variability of respiration amplitude was related to covert muscular activity. The standard deviation of these amplitudes for each subject were determined and appear as variable G. It and Number 29 were based on two to five experimental periods per subject. Standard Benedict-Roth apparatus was employed. Metabolic rate is in terms of the Boothby-Sandiford modification of the Dubois norms.[3]

The Downey Will-Temperament Test (4) was included in this experiment not only because it is one of the few tests which purport to measure temperament, but because of the experimenter's interest in that portion of the test referred to as "motor inhibition." If muscular tension is characterized by speed and magnitude of response, then a task which calls for the inhibition of speed and results in a minimum response amplitude should be performed better by the individual who characteristically operates at a low level of muscular tension. The test requires that the subject write a test phrase as slowly as possible. This test appears in Table 1 as Number 22.

Measures Number 26, systolic blood pressure, Number 27, diastolic blood pressure, and Number 28, pulse pressure, represent means obtained from a series of determinations on different days and were included because of Jacobson's (10) assumption that arterial hypertension bears some relationship to muscular hypertension. The auscultatory method was employed with the subject seated and the cuff attached to the upper left arm. The means were translated into standard scores derived from the age norms published by Richey (20) on over 1700 cases, thus eliminating the factor of chronological age. Diastolic pressure was taken at the incidence of the fifth or silent phase.

The measurement of individual differences in overt muscular activity has proceded along two lines--measures of frequency, and measures of speed. Under the first category are the following:

A. Rating of general activity --represents the mean of ratings by nine staff members of the Orthogenic School, all of whom were in daily contact with the subjects. They were instructed, "Will you please rate the following boys in relation to their general activity. The individual who is typically the most active will be rated as '1'; the boy closest to him in amount of general activity will receive a '2'."

B. Arm activity, and C, body activity --were measured by the Olson (18a) time-sampling technique. The measures were taken in the schoolroom when the subjects were engaged in reading. They involve a daily series of ten-second samples over a period of three weeks. Body activity included any movement of the trunk or legs.

D. Activity just before sleep, and E, activity during sleep[4]---represent mechanical measurements taken with Harvard work-adders which were attached

[3]The author is indebted to Dr. Margaret Sandiford of the University of Chicago Clinics for the determination of some of the metabolic rates. The remainder were obtained with apparatus made available through the courtesy of Dr. N. Kleitman of the Department of Physiology, University of Chicago.

[4]These data were taken in collaboration with Drs. N. Kleitman and N. R. Cooperman of the Department of Physiology, who are using them in another connection.

to the bed-springs. The recording meters were read at hourly intervals by the nurse in charge. The subjects retired between 9:30 and 10 P.M. The first reading was taken at 10 P.M. and the differential between it and the 11 o'clock reading has been regarded as a measure of pre-sleep activity. The data represent means of readings over a four month period and were rendered comparable by correcting for differences in weight of the subjects and sensitivity of the bed-springs.

Item F, which for want of a better name has been called uncontrollable activity, represents mean number of leg movements per minute which could not be or were not controlled when the subjects had been instructed to remain seated as quietly as possible for a series of ten minute periods during the skin resistance measurements. The blood pressure cuff of the Darrow apparatus was attached to the calf of the right leg, and any movement of that member was recorded as an abrupt change in the blood pressure curve on the photopolygraph tape.

Speed of response is represented by several measures. Number 18 is speed of writing on the Downey Will Temperament test. Number 24, mean rate of tonguing (in this case the ability to pronounce rapidly the consonant "d"), was recorded dictaphonically for a series of five-second periods on different days under instructions to tongue as rapidly as possible. Number 25, mean rate of key tapping under instructions to tap as rapidly as possible, involves records of a series of ten-second periods on different days obtained by means of a magnetic counter. The hand capable of making the most speed was used.

Number 23, median speed of movement, is a mixed measure. Besides Number 18, seven sets of data on normal speed of movement were collected, no one of which was reliable. By taking the median of the combined obtained rankings, a variable was obtained which reliably distinguished between the subjects. The data include Number 18, speed of writing, which was also listed as a separate measure because it was one of the Downey tests; a rating by staff members of speed of normal speech; speed of recitation of an overlearned paragraph from Lincoln's Gettysburg Address; speed of counting to thirty at a rate which was neither slow nor fast; speed of transversing an overlearned pattern on a raised nail stylus maze; speed of counting the 121 nails on that maze; speed of choice key tapping, where the subject was instructed to tap at a rate which seemed to him neither slow nor fast; and choice of a metronome rate which seemed neither slow nor fast, obtained by repeatedly increasing, then decreasing the rate of the metronome until the subject had made a series of choices. All of these measures except the rating of speed of speech, and the speed of recitation represent data collected on a number of different days. In only one, maze performance, did the subjects realize they were being timed.

Another measure which Downey at least includes in the Speed Group is Number 19, Freedom from Load, from her Will-Temperament test. She regards it as an index of tendency to maintain speed without external pressure. It is the ratio obtained by dividing the normal by the speeded time of writing, the material being the subject's name and a test phrase, each written twice under each condition.

Two other phases of the Downey test may be described here. One, Interest in Detail, Number 20, is measured by the exactness with which a model of handwriting is copied when instructions are given to copy it as exactly as possible. The other, Number 21, Volitional Preservation, is determined by keeping a record of the amount of time taken to devise a disguised handwriting.

Although measures of stability and emotional behavior obviously admix, two variables were available which afforded sufficient data for a measure of variability. One is shown as Number 34, which is the standard deviation of activity during sleep. The standard deviation of pre-sleep activity also was

obtained, but was found to be unreliable.

The other, Number 17, depicts what Spearman refers to as "oscillation." Following Madegan (15), two forms of Spearman's Straight and Curved Capitals test were used. The test requires the subject to distinguish the curved or straight characters of a series of capital letters coursing over a page by marking a straight or curved line underneath each. The subject places another mark at the instruction of the examiner every 15 seconds so that the variability of his rate of work may be obtained in terms of the average deviation from the mean. The individual with the least average deviation is the most stable worker, or oscillates least. This test was the least popular of the experiment. In spite of its low reliability (.50) it has been retained in part of the present analysis because of the interest which has been manifested in it.

It should be emphasized that any measure of emotional behavior is in a sense a measure of unstability though the converse does not hold. Emotions are by definition variants. The stable person is calm, phlegmatic, unemotional. Such a measure as frequency of emotional outbursts, Number 4, is thus essentially a measure of unstability. This item represents observations made over a period of three months by three staff members. Instructions were as follows: "A negative emotional outburst, for the purpose of this study, will mean a decided change in behavior which arises out of some FRUSTRATING situation and which persists for one or more minutes. It will include crying, sulking, grumbling, screaming, swearing, whining, striking, balking, etc." Rankings were obtained directly from the number of outbursts reported.

Other measures of emotional behavior include: Number 5, emotional lability, a rating by nine staff members of that behavior popularly known as "sensitiveness." Instructions to raters were, "We regard some people as 'thin-skinned' or 'easily hurt.' Their feelings seem relatively unprotected. They might be called emotionally labile. Will you rate---" etc. Number 8, the Woodworth-Mathews Personality Inventory, was scored in terms of the amount of positive or negative deviation from the age norms given by Mathews (16). Number 9, Schedule A, Number 12, Social B III, and Number 13, Emotional B IV, represent the mean judgments of three staff members in rating the subjects on the Haggerty-Olson-Wickman Behavior Rating Schedules (18). Schedule A is a composite of behavior problems while Schedule B attempts to differentiate between problems lying in intellectual, physical, social, and emotional spheres. All parts of the scale were used, the intellectual and physical divisions appearing as items Numbers 10 and 11 of Table 1.

Variables Numbers 15 and 16 were obtained from the word association test. The Woodrow-Lowell (26) revision of the Kent-Rosanoff list was used and presented following the manner employed by Luria (14). In this case the fingers of the subject's hands rested on two metal cylinders covered with rubber sheeting. The subject was instructed to press with the right hand when making a verbal response. Pressure changes exerted on the rubber tambours were pneumographically recorded on a polygraph tape. The subject and experimenter spoke into a Stoelting voice key and the incidence of both the stimulus and the response words was magnetically recorded. Variable Number 15 is the number of delayed responses. Following Wells (23) a response was regarded as delayed if it occurred three seconds or more after the stimulus word. Number 16 is the number of individual responses in terms of the Woodrow-Lowell norms (26). Any response appearing in zero or one case in a thousand was regarded as an individual response. Data concerning pressure changes from the involuntary hand and variability in the voluntary hand did not reliably differentiate between the subjects and so were discarded from the present analysis.

Variable Number 33, mean number of spontaneous galvanic skin responses per minute was obtained at the same time as variables Numbers 30, 31, 32, and F.

One other item should perhaps be classified with this group, Number 7, Good-naturedness. It is particularly a measure of behavior which has been referred to as "irritability," but its similarity to emotional behavior is apparent. It and the sole measure of aggressiveness, Number 6, were obtained from ratings by staff members.

Number 35, morphological index, was included because of the perennial interest in the relation of physique to temperament. Following McCloy (17) the form $\frac{\text{weight}^{1/3}}{\text{height}}$ was employed.

The foregoing description of the experimental procedure omits mention of several behavior items which were measured. All portions of the Downey Will-Temperament test were given but only the four mentioned distinguished between the subjects. Other data also were excluded because they did not reliably distinguish between the subjects. In this class fall measurements of pulse rate, spontaneous blood pressure variability, hand tremor on the Whipple Steadiness test and on the Luria apparatus, tachycardia after physical exertion, and perserverance of error on the raised nail maze. With the exception of Number 17, oscillation, no measure has been included whose reliability coefficient, when obtainable, was less than .60. Reliability was determined by obtaining the rank difference correlation coefficients for odd and even measures. These coefficients are shown in the following tabulation.

	Measure		p
A.	General activity		.95
B.	Arm activity		.96
C.	Body activity		1.00
D.	Pre-sleep activity		.94
E.	Activity during sleep		.92
F.	Uncontrollable activity		.93
G.	S.D. Respir. ampl.		.88
5.	Emotional lability		.68
6.	Aggressiveness		.94
7.	Good-naturedness		.64
9.	Haggerty-Olson-Wickman Behavior Rating Schedules	Schedule A	.61
10.		Intellectual B I	.88
11.		Physical B II	.93
12.		Social B III	.94
13.		Emotional B IV	.88
14.		Schedule B-total	.96
15.	Word ass'n. delayed response		.83
16.	Word assn. indiv. resp.		.89
17.	Oscillation		.50
18.	Downey Will-Temperament	Speed of writing	.89
19.		Freedom from load	.75
23.	Speed of movement (med)		.85
24.	Rate of tonguing		1.00
25.	Rate of tapping		.96
26.	Systolic blood pressure		.91
27.	Diastolic blood pressure		.78
28.	Pulse pressure		.94
29.	Basal metabolic rate		.92
30.	Initial skin resistance		.79
31.	Mean skin resistance		.96
32.	Per cent skin resistance		.85
33.	Galvanic skin responses		.96
34.	S.D. activity during sleep		.76

RESULTS

Since only six subjects were available for this experiment, it is obvious that no generalizations can be drawn. The results must be considered as pertaining to these six subjects only, and their sole value will be in the corroboration they may give to hypotheses already advanced, and in any new hypotheses to which they may give rise. In view of these considerations the value of a detailed presentation of the data is questionable. The description of the results will be confined therefore to an analysis of the table of rank-difference correlation coefficients which the data afford. The coefficients are shown in Table 1. While the table contains many items of individual interest a revision is needed before a systematic interpretation is possible.

According to the hypotheses which gave rise to the experiment, a table of

TABLE 1

RANK DIFFERENCE CORRELATION COEFFICIENTS FOR FORTY-TWO VARIABLES AND SIX SUBJECTS

| | | |

positive correlation coefficients would be expected. Inspection of Table 1 shows many negative coefficients. Since the measures were correlated with regard to magnitude only, negative coefficients are to be expected for some variables. Reflection of traits, however, did not entirely eliminate them. It was determined, therefore, to construct a new, positively correlated table around a group of highly intercorrelated variables.

In the absence of clearly defined measures of muscular tension, the internally consistent measures of overt muscular activity were used as the nucleus of the revised table. It is apparent from Table 1 that these are measures A, general activity as rated, C, body activity in the school room, D, pre-sleep activity, and F, uncontrollable activity in an experimental situation. Although their mean intercorrelation of .66 is not as high as might be expected it is positive throughout and suggests a common factor which would be measured more accurately by a combination of all than by any one alone. Accordingly, a composite variable ACDF was set up by the following formula cited by Holzinger (9, p.37).

$$\sigma^2\ 1+2+3+....+n = n+2(r_{12}+r_{13}+....r_{n-1,n})$$

From the standard deviation of the composite, the correlation of the composite with any test is obtained by

$$r_i(1+2+...+n) = \frac{\sum_{j=1}^{n} r_{ij}}{\sigma 1+2+...+n}$$

By this means the correlation of the composite ACDF with each test of Table 1 was determined. Table 1 was then reinspected in an attempt to locate other groups of tests which also might be combined. One pair, Numbers 24 and 25, rate of tonguing and rate of tapping, correlate .89. Combined they probably form a more accurate measure of maximum rate of movement than does either alone. Another such group includes tests Numbers 9, 12, and 13 of the Haggerty-Olson-Wickman Rating Scale, their mean intercorrelation being .94. Since each alone is a mixture of ratings on several questions, it seemed likely that a further combination would clarify rather than distort the picture. The new composite will be referred to as 9-13, "social behavior problems."

The revised table was then constructed by adding tests in the order of their correlation with the composite ACDF, if their correlations with each of the previously entered tests was positive. Coefficients within the range -.01 to -.19 were considered insignificantly negative, or zero. Tests were reflected if all coefficients were negative. Tests Numbers 7, 27, 30, 31, and 32 were reflected and are marked hereafter with an "x."[5]

Since the intercorrelation of tests A, C, D, and F did not approach unity, the composite ACDF was replaced in the obtained table by the individual tests. As this resulted in the appearance of only three more insignificantly negative coefficients, and one of -.26, which also is probably insignificant, the table was left in this form. It appears as Table 2. Since variables F and 27x have a correlation of unity, only one set of coefficients has been included. It thus represents both F, uncontrollable activity, and 27x diastolic blood pressure.

The next step was the analysis of Table 2, presumably into groups of

[5]From this revision certain tests were omitted. These include Number 17, oscillation, because of low reliability; Number 14, Schedule B-total, because it represents merely a summation of measures 10, 11, 12, and 13; and Number 18, speed of writing, since it already forms a part of measure Number 23, median speed of movement.

TABLE 2

VARIABLES FROM TABLE 1 WITH POSITIVE INTERCORRELATIONS

D	Pre-sleep activity																	
F,27x	Unc't. activity,D.B.P.	.83																
28	Pulse Pressure	.77	.71															
C	Body Activity	.83	.54	.49														
A	General Activity	.53	.36	.24	.84													
5	Emotional lability	.37	.60	.00	.43	.47												
30x	Initial skin resist.	.49	.71	.14	.49	.39	.94											
31x	Mean skin resistance	.31	.60	.09	.26	.10	.83	.94										
32x	Percent rise skin rst.	.37	.66	.26	.14	.00	.66	.83	.94									
7x	Good-naturedness	.23	.54	.11	.40	.27	.57	.71	.63	.46								
9-13	Social behavior prob.	.28	.61	.34	.34	.51	.62	.71	.65	.53	.91							
23	Median speed mov'm't.	.00	.09	.09	.00	.21	.14	.26	.31	.20	.74	.80						
4	Emotional outbursts	.16	.21	.33	.44	.70	.19	.24	.13	.00	.77	.79	.81					
29	Basal metabolic rate	.00	.31	.03	.03	.47	.43	.37	.26	.09	.74	.81	.77	.73				
6	Aggressiveness	.26	.26	.03	.66	.93	.54	.49	.26	.00	.74	.68	.49	.81	.66			
24-25	Rate of movement	.26	.36	.27	.44	.81	.27	.18	.09	.26	.59	.59	.44	.76	.79	.79		
G	S.D. respir. amp.BMR	.00	.20	.03	.09	.16	.43	.60	.71	.60	.71	.79	.83	.61	.49	.43	.09	
	Means	.38	.56	.27	.41	.48	.54	.45	.37	.57	.62	.37	.47	.43	.49	.43	.41	.43
		D	F,27x	28	C	A	5	30x	31x	32x	7x	9-13	23	4	29	6	24-25	G

tests which have some factor in common. According to Holzinger, (9, p.23), "This grouping is accomplished by means of a 'coefficient of belonging', the B-coefficient, which is the average of the intercorrelations of a certain group of tests divided by their average correlation with all the remaining tests. The B-coefficient gives an objective measure of the extent to which the tests in this group belong together in ascertaining the underlying factor." The work is begun with the two tests which have the highest correlation, and continued by adding the test which correlates the highest with the preceding tests. When the B-coefficient drops appreciably a new argument is begun with the next highest coefficient among tests not already involved in the first group.

Since the B-coefficient analysis indicated three clearly defined groups of tests it was determined to submit the data to factorial analysis. Holzinger's (9) bi-factor method, which assumes a general and group factors in a positive correlation matrix, was employed. The obtained factor pattern appears as Table 3.

The third and final step in the analysis aimed to discover the relationships of those tests omitted from Table 2 to (a), all tests included in Table 2, and (b), tests measuring factor groups of Table 3. These relationships are shown in Table 4 and were obtained by means of the same formula used in step one. Thus, variable Number 33 correlates .56 with composite D, F-27x, 28, and C; it correlates .68 with composite 5, 30x, 31x, and 32x; and it correlates .12 with the composite of tests measuring factor III. The mean of the correlations with the three composites, .45, is an approximation of its correlation with Table 2 as a whole.

DISCUSSION

In the discussion of results little direct attention need be given Table 1. The table has been included for purposes of reference, and in order that the reader may refer to any items which for him hold particular interest.

It will be recalled that relationships were postulated between individual

TABLE 3

BI-FACTOR PATTERN OF TESTS FROM TABLE 2

		I	II	III	h^2
D	Pre-sleep activity	.44	.94		1.07
F,27x	Unc't act,-D.Bl.Pr.	.80	.39		.79
28	Pulse Pressure	.25	.66		.50
C	Body activity	.56	.65		.74
A	General activity	.34	.44	.49	.55
5	Emotional lability	.74	.43		.73
30x	Initial skin resistance	.87	.55		1.06
31x	Mean skin resistance	.64	.79		1.03
32x	Percent rise skin resist.	.56	.66		.75
7x	Good-naturedness	.72		.58	.85
9-13	Social behavior problems	.82		.62	1.06
23	Median speed of movement	.17		.82	.70
4	Emotional outbursts	.33		.91	.94
29	Basal metabolic rate	.27		.84	.78
6	Aggressiveness	.51		.69	.74
24-25	Rate of movement	.42		.60	.54
G	S.D. respiration amp.BMR	.17	.77	.61	.99

TABLE 4*

RELATIONSHIP OF TESTS OMITTED FROM TABLE 2 TO TESTS INCLUDED IN TABLE 2

		Tests of factor groups			
		I	II	III	Mean
33	Galvanic skin responses	.56	.68	.12	.45
11	Physical behavior problems	.54	.38	.02	.31
34	S.D. activity during sleep	-.16	-.29	-.34	-.26
22	Motor inhibition	-.03	-.68	-.03	-.25
15	Word assn. delayed response	.34	.63	-.23	.25
10	Intellectual behavior problems	.26	.02	.36	.21
35	Weight1/3-height ratio	.10	-.77	.05	-.21
1	Chronological age	.07	.23	.17	.16
16	Word assn. individual responses	-.36	.23	.60	.16
20	Interest in detail	-.02	-.52	.21	-.11
B	Arm activity	.08	.18	-.58	-.11
21	Volitional perseveration	.24	-.43	-.07	-.09
2	Mental age	-.47	-.06	.26	-.09
8	Woodworth-Mathews Per. Inv.	-.47	.17	.16	-.05
19	Freedom from load	.39	.18	-.49	.03
E	Activity during sleep	.31	-.27	-.11	-.02
26	Systolic blood pressure	.26	-.35	.09	.00
3	Intelligence quotient	-.49	-.04	.52	.00

*Tests A and G omitted from their respective groups in these correlations because of overlap in group factors.

differences in (a) muscular tension, (b) overt muscular activity (speed and frequency of response), (c) unstability of response, (d) emotional behavior, (e) aggressiveness, and (f) irritability. Inspection of Tables 2 and 3 indicates that these relationships do obtain in the behavior of the six subjects of the experiment. Table 2 shows that measures in each of the above categories do cluster in a positive manifold. Table 4 shows tests which do not fall within that manifold.

The entries in the last column of Table 4 may be regarded as indices of the relationships between the omitted and included tests of Table 2. Entries have been made in the order of that relationship. It will be seen that tests 33, 11, 34, 22, 10, and 1 are alike in sign in their relationships to the groups of Table 3, and, after reflection of 22 and 34, might presumably belong in Table 2. Actually this is the case for all except Number 1, chrono-

logical age, which was not systematically related to any of the three groups, its correlation being only slightly more positive than negative, and low in most instances. The others, however, were omitted on the basis of only one or two negative correlations, which might well be attributed to chance. It is surprising indeed that, with so few subjects, more tests did not fall in this category.

The remainder of the tests of Table 4 are those which explain the large number of negative correlations, even after attempted reflection, in Table 1. It will be seen that they represent no systematic direction of correlation with the groups of Table 3. They are of particular interest for they should answer the question---do any of these measures tend to throw doubt on the postulated relationships? Little consideration need be given to measures 19, 20, 21 and 8. All four represent results from a single presentation of paper and pencil tests, the reliabilities of which may be questioned. Even though they be considered reliable, their nature is such that they need have little effect upon the conclusions. The same applies to 2 and 3, mental age and intelligence quotient, which were not expected to bear a systematic relationship. Items 15 and 16, delayed and individual response in the word association test, are also open to question concerning reliability, for in spite of the consistency with which they differentiated between the six subjects, they represent results obtained from only one test presentation of 100 stimulus words. It will be seen that each correlates over .60 with one of the three groups of Table 3 and low with the others. If the word association test were lengthened it seems possible that 15 and 16 might well cluster with the variables of Table 2. Number 35, morphological index, also shows a close relationship.

This leaves for consideration only measures B and E, arm activity in the school room and activity during sleep. Here the apparent contradiction of theory would be more serious were it not for the fact that four other measures of overt muscular activity are present. Inspection of Table 1 will show that these two variables did not correlate highly positive with the other four tests which were used to form activity composite ACDF. Arm activity was actually negatively related to the composite while activity during sleep was positively though insignificantly related. It can only be concluded that these two forms of activity are conditioned in these subjects by other factors.[6]

The proposed question can now be answered. None of the tests omitted from Table 2 offers important refutation for the conclusion that, for these six subjects, the original postulates may be regarded as substantiated. They do suggest that overt muscular activity is not a factor per se, and this inference is supported by the relatively low order of relation between tests A, C, D, and F. Possibly there is no such thing as a "hyperkinetic" child. The form of activity in which he manifests hyperkinesis probably must be stated.

There remains for consideration only the attempt to isolate group factors from Table 2. If the factorial method had already been applied to measurements of individual differences of this nature the present data would not justify the analysis. Since, however, no report of common factors in psychological and physiological behavior has yet appeared a preliminary attack on this problem seems warranted.

In view of the postulates it seems reasonable to regard the general fac-

[6]It is interesting to speculate on these conditions. Table 1 shows that in these six boys arm activity is related most closely to general inactivity, low intelligence, lack of aggressiveness, number of physical behavior problems and lack of ability for rapid reaction. Since all of the subjects of this study manifested behavior problems of various sorts this picture of apathy and aimless arm movements may be particular to these subjects. Activity during sleep is most closely related to age, rhythmical respiration during the metabolism experiment, variability of activity during sleep, volitional perseveration, and interest in detail. Since it is negatively correlated with most of the measures of muscular tension and the emotions, the speculation might be drawn that the calm, cautious individual is the more restless sleeper while the excitable, impulsive person "sleeps the sleep of the dead."

tor, Δ, as muscular tension; however, the evidence from the factor loadings is by no means clear. Interpretation of factor I is complicated by the presence of Number 28, pulse pressure, and 27x, diastolic blood pressure. Since, however, all of the other tests in this group represent overt muscular activity, and since one of these tests has a perfect negative relationship with diastolic blood pressure, overt activity may be regarded as the dominant picture of the factor.

If this is an adequate interpretation it is logical to expect a high correlation with Number 33, since overt activity also results in galvanic skin responses. Table 4 shows the correlation coefficient to be .56. The correlation of .54 with Number 11, physical behavior problems, is rather meaningless due to the heterogeneity of the measure.

Factors II and III are even more difficult to interpret. They manifest a mixture of physiological and psychological measurements.

It is believed that in variable Number 5, emotional lability, lies the key to this factor. It will be recalled that this was the rating of what was popularly called "sensitiveness." Presumably a person who is sensitive is one who reacts to slight stimuli. By inference he might be expected to react to constant stimuli in an exaggerated manner. He would thus be more reactive, more excitable, than the less emotionally labile person, and his greater reactivity would be apparent particularly in unusual situations such as the experiments measuring skin resistance, basal metabolic rate, and word association. Tables 3 and 4 show this to be the case. Moreover, measures Numbers 22, 20, and 35 correlate over .50 with the four tests of this factor. The picture is thus logically expanded to emotional lability accompanied by the inability to inhibit a motor response, by lack of interest in detail, all housed in an underweight, overheight organism. The correlation of -.77 between the tests of group II and morphological index suggests that this factor is not apprehension conditioned by previous experience, but is a variable with a physiological basis. Perhaps further use of factor analysis with personality data will reinstate body-build as an index of certain phases of individual variability.

Factor III includes four of the five ratings -- A, activity; 7x, badnaturedness; 9-13, social behavior problems; and 6, aggressiveness. If their clustering be explained in terms of halo-effect their correlation with the rest of the group remains unaccounted for. Viewed from the variables which correlate most highly with the factor--- 4, emotional outbursts; 29, basal metabolic rate; and 23, speed of movement- -the operation of the thyroid gland is suggested. Certain it is that in hyperthyroidism both emotional outbursts and speed of reaction are increased. The tests of Table 4 do not help in clarifying the evaluation. Let it be defined tentatively as thyroid function and the hypothesis put to experimental test.

The fact that these tentative factor designations do not seem to be mutually exclusive need occasion no concern. No illusions are held concerning their validity. Reliable factor loadings and, possibly, reliable factors cannot be expected from an analysis based on six cases. They do, however, furnish a definite pattern around which to fashion further research. Furthermore, they show that at least in these six subjects there is no dichotomy of physiological and psychological traits. Typical measures of personality differences which are often attributed to environmental influences are shown to cluster with measures of physiological differences and to bear definite relationships thereto. Impetus should be derived for further physiological studies of personality.

SUMMARY AND CONCLUSIONS

The hypothesis was derived that individual differences in characteristic level of muscular tension in the skeletal musculature are positively related to differences in 1) frequency of overt muscular activity; 2) speed of movement;

3) emotional behavior; 4) unstability of response; 5) aggressiveness; and 6) irritability. The postulates were put to preliminary experimental test with forty-two variables and six male subjects ten to fourteen years of age. The data yielded a table of positive correlation coefficients for 21 of the variables, including all those of fundamental importance for the preliminary confirmation of the hypothesis. A bi-factor analysis of the correlation matrix discovered a general factor (presumably muscular tension level or its analogue) and three group factors. No dichotomy of physiological and psychological variables was found. It is concluded that, for these six subjects, the data substantiate the hypothesis, and that the relationship of muscular processes to personality differences warrants further investigation.

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A COMPARISON OF CERTAIN PERSONALITY TRAITS AND INTERESTS IN DEAF AND IN HEARING CHILDREN

ISOBEL GREGORY[1]

Most comparative studies of deaf and of hearing persons have dealt with intellectual abilities. Pintner (8), Goodenough and Shirley (1), Peterson and Williams (6), and MacKane (4), using various tests, all reached the conclusion that deaf children on the average are mentally retarded. The findings of Long (2) and of Lyon (3), comparing hearing and non-hearing groups of children as to motor ability, are inconclusive, though Lyon reports that 44 per cent of the deaf boys he tested fell below the 30th percentile on the Minnesota Mechanical Ability Tests. Previous studies of the personality differences between deaf and hearing children by Madden (5), Rabinovitch (9), and Welles (10) have suggested a lack of initiative and have shown considerable evidence of personality maladjustment in both children and adults who are hard of hearing. Pintner (7) concluded from his test that the deaf are more neurotic, more introverted, and more submissive than those who hear normally, and Lyon found deaf boys presenting more emotional problems than hearing boys.

The purpose of the present study was to compare the responses of deaf and of hearing children in institutions as to certain personality and interest items. The two groups of subjects comprised 128 children at the School for the Deaf at Faribault, Minnesota and 156 children at the School for Dependent Children at Owatonna, Minnesota. Both groups were known to be intellectually retarded, so that the factor of intelligence was fairly adequately controlled; and since all the children were under institutional care, the socio-economic factor was also controlled.

Only those subjects were included who had a reading age of nine years or over, as determined by the Stanford-Achievement Reading Test. Chronological ages ranged from thirteen through eighteen years. Reading ages of the hearing children approximated their chronological ages more nearly than did reading ages of the deaf children.

The groups selected to take the personality and interest tests are shown in Table 1. The two groups were paired as closely as possible on the basis of age and sex. There were 25 pairs of boys and 32 pairs of girls.

The children filled out the test blanks in their classrooms, under the supervision of either the experimenter or a teacher. All of them seemed interested and cooperated willingly when the test was explained to them. The introductory statement on the test blanks read: "The questions in this booklet were given to some boys and girls in New York and some in California, to find out what boys and girls think and the things they wish for. We are giving it now to some Minnesota boys and girls to find out what they think and the things they wish for. There are no right or wrong answers. Each one will answer the questions differently. Just try to put down what you really think and really wish." Similar instructions were also given the subjects orally, and the fact impressed on them that the tests had nothing to do with school work.

The personality test consisted of three parts. Part one was a section from a Minnesota Interest Blank in which the subjects were either to select in order of desirability three wishes from a list of thirty-one presented, or to name their own.

Part two was a revision of the fourth part of Roger's Test of Personality Adjustment, and of eighteen questions from the Woodworth-Cady Test of Emotional Stability. The eight-point scale that Roger used was changed to a

[1]From the Institute of Child Welfare, University of Minnesota.

TABLE 1

NUMBER OF CHILDREN OF VARIOUS AGES IN THE TWO SCHOOLS WHO TOOK THE TESTS

Chronological Ages in Years	Faribault School for the Deaf			Owatonna School for Dependent Children			Both Schools		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
13-13.9.....	4	3	7	4	2	6	8	5	13
14-14.9.....	4	3	7	3	6	9	7	9	16
15-15.9.....	5	6	11	8	7	15	13	13	26
16-16.9.....	3	12	15	7	7	14	10	19	29
17-17.9.....	2	4	6	2	10	12	4	14	18
18-18.9.....	7	4	11	1		1	8	4	12
Totals	25	32	57	25	32	57	50	64	114

three-point scale. The questions to be answered after each statement were "Am I just like her (or him)?" "Do I wish to be just like her (or him)?" The answers to be checked were either "Yes," "No," or "Sometimes." This method of checking provided a simple basis for comparing the results. The Woodworth-Cady questions were reworded to fit the indirect form of the Roger questions, and the same three-point scale was used for them.

Part three was the same as section five on the Roger Test of Personality Adjustment, except for the omission of questions 6, 8, and 18, which concern children's relations with their parents, and the addition of a question about the frequency and kinds of dreams the children had. A list of subjects known to be common in children's dreams--falling, eating, playing games, etc.--was followed by instructions to the subjects to add any other things they dreamed about and to "put X before the things you dream about sometimes, and XX before the things you dream about often."

The play interest blank, on which the subjects checked both the frequency and the desirability of participating in ninety different play activities, was the one used in the California study of gifted children.[2]

The items of the three parts of the test, except for the one concerning dreams, were classified under three general divisions: personal characteristics, individual's social adjustment, and individual's adjustment to the material environment. All the comparisons that follow are based on items for which the $\frac{\text{Diff.}}{\sigma \text{ diff.}}$ between the rating of the deaf and that of the hearing children was greater than 2.

Personal Characteristics. Of the four items concerning fears, three were checked more often by the deaf than by the hearing children. More deaf than hearing children stated that they were afraid of fire and that they sometimes wished not to be afraid of being left alone in the dark. More hearing than deaf children said they never feared fire, though a considerable number of hearing children expressed occasional fear of being left alone in the dark.

There was some confusion apparent in the deaf children's answers to questions regarding emotional tone and attitude toward life. Many of them, for instance, appeared not to understand what was meant by the colloquial phrase, "getting a square deal from life," though a significantly greater number of deaf than of hearing children said they did not feel that they were getting "a square deal."

The deaf children's answers to questions relating to health indicated that they were in poorer health than the hearing children. Since no specific information on the health of either group was available, it is impossible to say whether

[2] Terman, L. M., Genetic Studies of Genius, Vol. 1, p. 388.

this was actually so, or whether the deaf children's answers indicated a slight neurotic tendency in this group.

More deaf than hearing children said they had no objection to doing what other people told them to do, whereas more hearing than deaf children said they sometimes did not want to do what they were told. This is in line with previous findings that deaf children are inclined to be more dependent than hearing children.

There was a slight, but scarcely significant, preponderance among the hearing children of the desire to "go away and have a lot of exciting adventures." The fact that this desire was less typical of the deaf than of the hearing is suggestive of the greater desire of the deaf for protection--a desire further suggested by the fact that more deaf than hearing children wished to be younger than they were. The narrow range of experience of the deaf may have prevented them from fully understanding what this item meant.

Social Adjustment. The only children who said they "did not care a bit whether people liked them or not" were seven deaf girls. A greater number of the deaf than of the hearing indicated that they wanted more friends than they had, while a greater number of the hearing than of the deaf said that they tried hard to make people like them. More of the deaf than of the hearing children said they did not get on well with their teachers, though more of the hearing than of the deaf expressed a desire to do better than they were doing in school. There was a greater tendency among the deaf than among the hearing to make the claim that they were "the brightest in school."

The deaf children showed a decided inclination to wish for isolation from social contacts. This might, of course, be expected, since their handicap makes social participation difficult.

Adjustment to Environment. In regard to material possessions, the hearing children appeared to be more satisfied with their clothes but more desirous of money than the deaf. At the school for the hearing children there is a large swimming pool and lessons are given the children--hence a smaller number of hearing than of deaf children expressed a wish to have swimming lessons. At the school for the deaf the children are encouraged to engage in Scouting, so that fewer deaf than hearing children said they wanted this type of activity. The smaller interest in dancing lessons among the deaf than among the hearing children may have been due to the difficulties attending this type of recreation for the deaf.

Dreams. The deaf children reported dreams about going on trips, or of visiting, to a significantly greater extent than the hearing children did. This type of dream is at variance with their expressed wishes, and may lend support to the theory that dreams are the expression of suppressed desires. More hearing than deaf children said they dreamed about movies, stories, and actors and actresses--a type of dream pretty much in accord with the usual interests of adolescents.

Play Interests. Comparison with previously published standards showed that, on the average, the institutionalized children were less mature in their play interests than children not living in institutions, and the deaf group were less mature than the hearing group. The hearing girls at the Owatonna school tended to be more masculine in their play interests than the deaf girls at Faribault.

CONCLUSIONS

The most characteristic difference between the two groups of institutionalized children was the tendency on the part of the deaf to withdraw from social participation and responsibilities. This tendency is shown in their desire

to be younger and more dependent and to isolate themselves from social pastimes. The greater desire on the part of the deaf for more friends, as well as their inability to get on well with their teachers, suggest an insecure social adjustment. The less adequate emotional adjustment exhibited by the deaf also indicates their less satisfactory adaptation to adolescence.

Until studies similar to this one are repeated in a number of institutions, the differences noted between deaf and hearing children cannot be attributed unquestionably to the sensory handicap of the deaf, although the differences found by means of this study are all in line with those set forth in the literature. Further comparison of similar institutional groups with institutionalized sick or delinquent children would be of interest.

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THE RELATION OF REACTION TIME OF FIVE-YEAR-OLD CHILDREN TO VARIOUS FACTORS

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The reaction time experiment is so old that little needs to be said of it by way of introduction. Few psychological phenomena have been studied so frequently or in relation to so many factors. The purpose of the present research was to study the speed of reaction to an auditory stimulus by 5-1/2-year-old children, in relation to sex, occupational status, intelligence, reaction time of adults on the same kind of test, introversion or extroversion, and physical well-being.

Subjects were Minneapolis public school kindergarten children, 50 boys and 50 girls, aged from 5 years 5 months to 5 years 7 months; and 25 women having an average age of 22.9 years. The apparatus used was the Miles Reaction Board with accessory key, the main board being held by the experimenter and the extension placed before the child being tested. Each day's testing consisted of 25 trials divided into groups of 5 with a rest of 15 seconds between each group, this being increased to 30 seconds between the third and fourth groups. The child was allowed to watch the clock during preliminary trials while the test was explained to him, but this was not allowed during the real testing period.

Since the motor type of reaction is generally considered to be shorter than the sensory type, an attempt was made to keep the child's reaction muscular rather than sensory. He was frequently reminded to watch his finger and have it ready to press the key when the buzz came, while words like listen and hear were avoided. The children's reactions, however, were very likely mixed, some muscular and some sensory.

Odd-even correlations (Spearman-Brown corrections) were .952 for boys, .981 for girls, and .970 for adults. Test-retest coefficients for the children ranged from .781 to .901, for the adults from .597 to .809, and did not increase consistently from day to day.

Table 1 summarizes the results of the entire test. In the column labeled Q_3 are given the means of the 75th percentiles, in the column labeled Q_1 the means of the 25th percentiles. Our speediest adult mean of median scores for one day was 146 sigmas. This is slower than the average found in the literature, which is under 130. Perhaps the difference is due to the fact that all our adult subjects were females, whereas scores made in previous studies have shown a sex difference in favor of males. Moreover, giving the tests in groups of five, while it aided the children, may have had the opposite effect on the adults. The mean variation from 14 to 17 sigmas found for our adult subjects is comparable to or less than that recorded in the literature.

Reference to the table will show that our child subjects made a decided and continuous day-to-day betterment, whereas the gain made by the adults was very small and did not increase more than one sigma after the second day of the test. The uniformity of all scores increased with practice. No gain in uniformity was made by the adults after the fourth day, but the children were still gaining on the sixth. Girls on the sixth day of the test reached 55 per cent of the adults' speed. Every day after the second a few of the quicker children exceeded individual adult scores, and one boy almost equalled the mean adult score on his sixth day of testing.

Several previous investigations (1, 3, 5, 6, 10, 12, 13) have shown correlations ranging from .03 to .58 between reaction time and various measures of intelligence. Our conclusions in the present test are very similar to those of

[1]From the Institute of Child Welfare, University of Minnesota.

TABLE 1

REACTION TIME DATA (IN SIGMA UNITS)
FOR THREE GROUPS OF SUBJECTS IN SIX DAYS' TESTING

Day of Test	Individual Means					
	Q_3	Q_1	Median	SD	MV	SD of MV
			Boys (N = 50)			
1	241	302	267	34	42	18
2	223	272	245	26	35	11
3	205	251	226	23	32	11
4	201	244	222	25	30	10
5	191	233	212	22	28	7
6	191	226	208	22	25	6
Last 4 days	196	239	217	21	29	5
			Girls (N = 50)			
1	249	317	279	36	47	16
2	234	288	257	36	39	13
3	217	265	241	35	35	10
4	206	257	230	29	35	10
5	198	244	220	30	32	9
6	191	234	212	24	29	7
Last 4 days	202	251	226	28	33	5
			Adults (N = 28)			
1	142	168	154	13	17	6
2	137	160	147	15	16	5
3	137	161	148	9	15	4
4	139	160	149	11	14	5
5	136	157	146	11	14	3
6	136	159	147	12	14	4
Last 4 days	137	160	148	10	15	3

Tinker (14). We found correlations of .300 for boys and .117 for girls between median scores on the Detroit Kindergarten test and first-day reaction speed medians. In the case of the girls, however, this correlation was unreliable. The correlations increased with practice, reaching a maximum of .50 for boys on the fifth day and .30 for girls on the third day, but subsequently decreased again so that by the sixth day the correlations were .36 for boys and .12 for girls, i.e. they were similar to those of the first day.

Many previous studies of reaction speed have not considered sex differences, but when a comparison has been made (2, 3, 5) it seems to have been always in favor of males. The sex differences found among our child subjects in both speed and variability were very small and unreliable and were reduced almost to zero by the six days of practice, yet they were consistently in favor of the boys.

Included in this experiment were 25 children of each sex from the three lower socio-economic groups and an equal number from the three upper groups, the Goodenough-Anderson scale being used as a basis for classification.[2] For every test and for both boys and girls it was found that median scores of the two highest groups were better than median scores for the two lowest. The contingency coefficients for the six days were .566 for boys and .542 for girls. We may conclude, therefore, that children from the higher occupational groups appear to have a faster reaction speed than those from the lower groups.

There are several reports (4, 7, 8) of attempts to relate reaction speed to various physical conditions. Our findings showed low positive correlations between nutrition indices (calculated for the entire group of children) and physi-

[2]Experimental Child Study, pp. 234-44.

cians' ratings (available for 28 boys and 24 girls). Though these correlations were virtually all unreliable, their consistently positive character, plus the fact that comparatively large contingency coefficients were found, lead to the conclusion that there is a slight tendency for physical well-being to be related to speed of reaction.

Using the Marston Introversion-Extroversion Rating Scale (9), it was found that extroverted boys appeared to be speedier than introverted. Girls near the average on the extroversion-introversion scale were speedier than those at either extreme. For boys there was a mean correlation of .248 between speed of reaction and Marston's "energy" traits and of .205 between speed of reaction and Marston's "emotional" traits. For girls, however, corresponding correlations were virtually zero.

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THE SOCIAL DEVELOPMENT OF THE YOUNG CHILD

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It is my purpose in this contribution to try to give to parents and teachers some conception of the vivid and highly emotional drama in which their preschool children are each playing a leading role. Anna Freud has said: "Psychology will have achieved what education has a right to expect of it if, on the one hand, it describes the primitive nature of the child and, on the other hand, opens up new avenues for possible development and new techniques for the further expansion of the child's personality."

These children whose education is now so much in the forefront are not static, crystallized, already formed personalities. They are plastic, dynamic young individuals in a state of constant change, or better, growth. Patterns of behavior or symptoms present this month may have disappeared to be replaced by other patterns of behavior or symptoms next month. Each one of these behavior patterns, whether socially acceptable or not, has significance as an expression of the child's effort to solve the conflict between the demands of his own instinctive life and the demands of his social environment.

The aim of the nursery school and kindergarten teacher and the parent of today is to provide a setting for the preschool child where he can develop into a mature individual, whose instinctive needs are adequately satisfied and who, at the same time, is a socially responsible person. To put it in other words, we want our children to accept happily and without conflict the discipline which the community imposes on each of its members, in exchange for protection and social satisfactions.

When we observe the newborn human infant we realize first of all that he is the most helpless and dependent of creatures. Alone he cannot fulfill his simplest of needs, but in spite of his complete dependence on society, he remains for the first few months of his life a completely asocial being. His mother, on whom he is so dependent, is not for him a personality with whom he has a relationship. She is merely an extension of himself, with the sole function of assisting him in the attainment of his bodily needs, pleasures and comforts. For the first months, even year, of his life these bodily needs and pleasures are related to the taking in of nourishment and sucking. The child's first conflicts with his social environment are almost invariably related to his desire to gratify his impulse to suck. The pediatrician's rigid feeding schedule does not allow him to be fed whenever he wants to be fed. Nurses, grandmother, aunts and friends all bring pressure to bear not to let him suck his thumb or his toys. Very early the young child discovers that the adults upon whom he is so completely dependent are at war with him insofar as gratification of his bodily desires is concerned.

During the second year of his life the child again meets with considerable opposition from the adults of his environment. No longer is he allowed to wet and soil himself when and where he pleases. His mother is insistent that he become clean in his toilet habits and that he accept adult standards of what is nice and what is nasty, what is clean and what is dirty. Many things which the child during his second, third and fourth years discovers as sources of pleasant bodily sensations are forbidden him, often in threatening, frightening terms. He is told not to pick his nose, not to scratch his ear, not to make clucking noises with his tongue and particularly not to handle his genitalia or masturbate. His impulse to investigate everything within reach, to handle it and often to destroy it, meets with emphatic disapproval. "Mustn't touch that", "That's a no-no", "You can't have that because you will break it".

[1]Psychiatrist, The New England Home for Little Wanderers, Boston, Massachusetts.

When the child of three or four hits or knocks over a baby sister or brother who is now getting the loving attention he once had, - with none of the prohibitions he now has, - he is scolded or even severely punished.

The infant and the young child wants what he wants when he wants it and he uses every means at his disposal to get it. When frustrated in his effort to attain immediate satisfaction of his every want he resorts to outbursts of temper. However, in the course of his first six years and by the time he enters first grade at school, he has already learned to give up or renounce many of his wishes, and to accept postponed satisfaction of others. His sense of values has begun to shift from short-time to long-time satisfactions. But how has this shift in values taken place? Why does the child who was oriented only towards the attainment of his individual wants, now make room in his world for the wants of others? His aim is no longer merely for the immediate gratification of bodily needs, pleasures and comforts. The change has taken place because the child in the course of his development has discovered that those who originally merely catered to his wants and needs, can satisfy another growing instinct in him. They can love him and be loved by him. Being loved and being approved of becomes increasingly important to the small child. For the sake of holding the love of the grown-ups who care for him, he is willing to sacrifice the bodily pleasures which his love objects demand that he give up. His own individual gratifications are renounced in favor of love relationships to the people of his environment. Aggressive and hostile impulses directed against those who frustrated his attainment of immediate pleasure are replaced by feelings of tenderness and solicitude for these same people who have now become love objects. There is even tenderness for brothers and sisters in imitation of the attitude towards them of the parental love objects. Many of the child's former, purely selfish, bodily gratifications now obtain satisfaction in a changed or sublimated form which is socially acceptable. The child who formerly hammered for the physical joy of the activity and the pleasure in the sounds and sight of Daddy's cigarette box being smashed now hammers two boards together to make a boat.

In spite of all his renunciation and sacrifice and sublimation of his childish impulses the little boy or girl still cannot completely monopolize his much desired love objects. Mother belongs not only to him but also to Daddy and to brothers and sisters and to all sorts of outside interests. Daddy, too, much loved as he may be, cannot be dominated as the small child would like to dominate him. So, since the little child cannot make his parents his own in reality, he, so to speak, incorporates them into himself. That is, he adopts as part of his own personality and point of view their attitudes and their standards of behavior and morality. This new part of him is now at war or in conflict with the infantile, instinctive little creature that had as a sole aim, the immediate gratification of bodily pleasure.

Most children by the time they are 5, 6 or 7 have reached a beginning compromise within themselves between their instinctive demands and the demands of society as interpreted to them by their incorporated love objects or social conscience. The behavior patterns and symptoms of the small child are to be regarded as his successive efforts at finding a solution for his conflicts - between himself and his frustrating parents, between himself and his brothers and sisters, and finally between the older and new parts of his own personality. How successful the child will be in utilizing to the full his potentialities and native endowment is dependent on how successfully he succeeds in solving these conflicts common to all of mankind. His first 6 years is a vitally important period of his life and a determinant of his whole future. The child, as he grows up, repeats over and over in his relationship to people the patterns he has worked out as solutions to his conflicts at home.

As an illustration of this universal tendency to repeat, in adult life, pat-

terns of behavior laid down in childhood let us consider a case history. For the sake of clarity I have selected material from the case of a girl who in childhood had to deal with emotional conflicts too great for her to solve by behavior patterns which would lead to mental and emotional health. In tracing the development of the sick or poorly adjusted personality, we can see in relief processes which are present in the well-adjusted and healthy but which do not stand out. In psychology, as in physiology, our perception of how and why functional patterns develop as they do is made clear by observation of pathological cases where too great weight or emphasis throws light on one or another dynamic process.

Case #1.

Mary is a housemaid of 24 years. She has never been able to hold a job for more than a few months because of her inability to get along with her employer or with other employees. She is a young woman of superior intelligence, as indicated by psychometric tests, as well as by her having succeeded in getting through high school against the odds of supporting herself from the time she was 15. She is attractive and is scrupulously neat and clean. Mary is a person who invariably succeeded in creating a favorable impression with the result that she never had any trouble in finding herself a position. For the first few weeks in any new job her work was always above criticism. During this period her employers had boundless enthusiasm for her and spoke of her sweet manner and gentle tactful handling of small children in the home. Then, as time went on, troubles began to pile up. If there were other maids in the household Mary began to accuse them of being lazy and irresponsible. She compared their inefficiency to her own painstaking work - which did not make her popular with cooks or nurses as the case might be. If anything went wrong in the house Mary felt that her mistress was blaming her unjustly. She became disturbed, not only about working relationships but also about the social relationships of her mistress and other employees. In one home she accused the adolescent daughter of her mistress of immoral sexual behavior. In another home she reported to her employer that the cook was "out all hours, doing goodness knows what". She intimated several times that her employer's husband or grownup son or guest was making improper advances to her. Coincident with this preoccupation concerning the working and social relationships in the household Mary's efficiency in her work diminished. When her employer spoke to her, even in a kindly way, about some carelessness she became sullen and seethed with inner wrath at what she regarded as an unjust accusation. She took all correction as an indication that her employer did not like her and wanted to be rid of her. It almost seemed that Mary then tried by her actions to provoke her mistress into having to dismiss her. When finally discharged she took a martyred satisfaction in her unhappy fate. It was her attitude that again she had been misunderstood, abused and rejected. On one occasion she lost a job because, after being called to task for some negligence in her work, she became irritated at her employer's 17 months' old child and slapped him.

Mary's pattern was to "sell herself" to a new employer as a superior person with idealistic strivings and some cultural ambitions. After being well-established in a position she became nervous, suspicious, resentful and accusing. She felt herself discriminated against and disliked by her mistress and she provoked rejection which proved to her that her suspicions and feelings that she was not wanted were justified.

The features of Mary s case reported above have roots in the emotional situations in which she found herself in her childhood. Now, in adult life, we see her repeating projections, rationalizations, self-justifications and defense mechanisms which in her childhood served her as solutions for conflicts between herself and her frustrating parents, between herself and her siblings and between the older and newer parts of her own personality. Space does not permit a complete reconstruction of Mary's childhood. However, a brief survey of her particular situation in her family will throw light on the unhappy, adult behavior patterns described above. We shall see that Mary's patterns developed early in life in response to her need to work out compromise after compromise between her inner self and the outer world with which she was confronted.

Mary was the second of three children. Her parents were never happy with each other and were both resentful of her birth which followed 11 months after the birth of Betty, the older sister. From the beginning Betty was the favorite of both the father and mother. When Mary was 3 her brother was born and it seems possible that her accusations are true that he was the child of another man than her father. Mary was bitterly jealous of this baby boy, whose birth deprived her of whatever advantage she had had as the baby in relation to her mother. The baby brother died while still in infancy. It is significant that following his death, Mary's favorite form of play - which had a compulsive character - was to "kill" her dolls and bury them. She developed anxiety about being alone in the dark or in closed places - an apprehension which has remained with her up to the present time. From the ages of about 4 to 7 she suffered from night terrors and in adolescence she began having frequent anxiety dreams which have persisted. In the course of studying her it became apparent that Mary's hostility for the baby brother had been so great that she had wished him to die. His death in reality had come as a gratification of her wish and her deep reaction was: "I wished my brother s death. My wish has killed him so I am guilty and I'll be punished." From the age of 5 or 6 on Mary became increasingly solicitous and protective of small children, as a defense against or reaction to her dangerously hostile wishes towards young usurpers of a mother's love. In the episode of her angry slapping of her mistress' 17-months-old son, following a rebuke which she took to be a rejection, Mary's old hostile impulses succeeded in breaking through her defenses against them.

In childhood Betty was held up to Mary by her mother as an example. Betty seemed always to be right and Mary always wrong. As a matter of course, new clothes went to Betty to be handed down to Mary. Early in life Mary began to try to create new situations in which she could be the favored one and could escape her unbearable position at home. She went to her grandmother or to neighbors to bask in the attention and admiration her precocious manner won for her. To

offset Betty's success in the family situation, Mary threw herself into school life with enthusiasm and struggled to hold the place of teacher's pet. It became her ambition to be a teacher when she grew up. Betty, never a success in school, was looked upon as inferior by Mary. As time went on Mary became more and more resentful that Betty, who was "dumb and lazy", was still the favorite of the family. She considered that both parents discriminated against her - the clever and ambitious child - in favor of her good-for-nothing older sister. In puberty Betty showed strong heterosexual interests and was popular with the village boys. Mary was jealous but defended herself by looking down on Betty, just as she now scorned her mother. She regarded them both as frivolous and immoral. She became increasingly disagreeable at home and openly accused her mother of failing in her duties and of setting a poor example for her daughters. Her mother, in desperation, took the attitude, "Well, if you don't like me why not go and live somewhere else." Mary took her mother at the face value she herself had provoked and with resentment she left home and obtained her first job as a mother's helper. She firmly believed that, through no fault of her own, she had been put out of her home and permanently rejected.

This outline of Mary's childhood reactions to her family background shows obvious parallels to her subsequent life trends. Over and over again as an adult she got herself into situations in which she could carry on the battles of her childhood. Her social relationships in each new environment inevitably took on the color of her childhood relationships. Competition in work always remobilized her old competition with her sister. The slightest rebuke from her employer reawakened her feelings of frustration and rejection by her mother. Her reactions to new people and events became almost photographic reproductions of earlier reactions to people and events at home. Mary continued to try to reach a compromise between the older and newer parts of her personality in symptoms such as her fear of small enclosed places, her bad dreams and her outbursts of aggression, as well as in other symptoms not gone into in this report.

Having seen of what far-reaching significance are the events and relationships of the child's first 6 years, we come now to the task of education - which is the function of the home, supplemented by the kindergarten after the child has begun to master the first rules of social life. This preschool education is not the formal presentation of factual information which the child will encounter later on in the grades but is rather a matter of allowing and forbidding, encouraging and discouraging the child's gratifications of his primitive, instinctive impulses. If he is allowed too complete or too frequent gratification of his infantile asocial wishes, he remains satisfied with life at a primitive, childish level. He is fixated at what should have been merely a passing phase in his development. His satisfaction is so great that he has no strong motivation for proceeding with the drama of his emotional development. It is this child who has been allowed too complete instinctual gratification who, in later years, is apt to fall into the category of delinquency or perversion.

Case #2.

Sidney, a 12-year-old boy, was referred to the New England Home for Little Wanderers by a school truant officer. Though of good average intelligence and free from specialized learning disabilities Sidney was not progressing in school and apparently he did not care. His tendency, according to his teachers, and to all who knew him, was to lie down on every job assigned him that made any demands upon him. He was unable to accept even a minimum of work and whenever he felt that things were not going as he wished, he became sulky and refused to cooperate further with the social group. He, as it were, took flight from a situation that did not cater to his every whim. Sidney was absent from school more days than he attended but always he was able to bring a note from his grandmother attesting to the fact that he had been at home, sick in bed. His obvious robust good health belied this excuse of frequent illness. It was reported in the neighborhood that Sidney was sometimes seen out fishing or wandering about the hills nearby during school hours.

Sidney was suspected of being responsible for some petty thievery. He had a habit of "borrowing" bicycles without the knowledge or consent of the owners. The truant officer was assigned the task of checking up on Sidney's activities. When he called at Sidney's home Sidney was not there. His stepmother said, in a resigned voice: "Well, I thought he was at school but if he is not you'd better look for him over the hill at his grandmother's." She went on to say that she had given up trying to do anything with Sidney, that though he was supposed to live at home with her and with his father, he spent much more than half his time with his grandmother. "She's got him so spoiled he's not good for anything." The truant officer went on to the grandmother's cottage where he found Sidney in bed, surrounded by comforts and good things to eat. He was basking in the solicitude of his grandmother.

Sidney's story is almost a caricature of the pampered child. His own mother died at the time of his birth. He and his father were taken into the home of his dead mother's mother. His grandmother, a lonely woman, who had had no son of her own, lavished all her love and vast energy on little Sidney. Her whole aim seemed to be to protect him from any thwarting or frustration. She over-fed him and over-coddled him. His slightest wish or need received her undivided attention. Sidney had no motivation for applying himself to anything except receiving gratification and adulation without the expenditure of any effort. His first 8 years were spent in this hothouse environment. His father then remarried and brought his new wife into the home. She soon found the situation impossible, so they moved to a home of their own, supposedly taking

Sidney with them. The stepmother did her best to help Sidney stand on his own feet and take some responsibility. Sidney could not accept the privation entailed by responsibility; so, what his stepmother would not give him he took or went back over the hill to his grandmother where things again were easy for him. But his grandmother could not possibly keep up with the imperious demands of this growing boy. All she could do was to try to protect him from the consequences of his anti-social acts. His behavior was based on his philosophy that the world was his by right and that there existed no authority superior to himself.

One can see in this boy's present reactions the pattern of an unhappy, constantly frustrated future unless something interferes to break down the vicious circle. The danger is that as a grown-up man Sidney will try ineffectually but over and over again to recreate the childhood situation of gratification of every impulse. His childhood prepared him to meet only that one infantile condition of life. Sidney had no need to exert himself to hold his grandmother's (mother's) love and there was no motivation for sublimation of his impulses.

On the other hand, a child who has been forbidden too much or who has too early been forced to conform to adult standards, runs the risk of later showing neurotic traits, ranging from simple inhibitions in behavior to a diversity of psychoneurotic symptoms. This child has had to put aside or repress his unsatisfied impulses. He has had to do this before he was able to sublimate them into useful, creative activity from which he could get a substitute satisfaction.

Case #3.

Douglas, a 10-year-old boy, was referred to the New England Home for Little Wanderers by his school principal. His teachers had been puzzled by his adjustment ever since he began coming to school. He was an attractive, bright child, with unusually pleasing manners. His good behavior and extreme neatness made him a favorite of all the adults with whom he came in contact. But he was totally unable to get along with other children. Even the girls regarded him as a "goody-goody" or a "sissy", and he was the butt of many a joke. He at first struggled valiantly but pathetically to win himself social standing. He brought flowers and candy to his teachers and he tried to introduce dramatizations of history stories to his playmates as a playground occupation. The ridicule of his contemporaries soon caused Douglas to withdraw into himself. He became progressively more isolated from the group and sought his satisfactions in imaginative play by himself. While occupied with something else his fingers were often in his mouth. He developed some facial tics, accompanied by sucking noises. His school teachers were particularly concerned by his failure to learn. His first two years of school had given promise of considerable academic success but, just as he withdrew energy from forming social relationships, energy was also withdrawn from his studies. Douglas continued to struggle with his lessons. He tried desperately hard to bring in perfect arithmetic papers and to spell correctly all the words given but what he learned he forgot, what he knew he seemed unable to reproduce and his anxious struggle for perfection interfered with his concentration.

Douglas was an obviously inhibited, disturbed little boy who showed what might be the beginning of severe neurotic symptoms or even of a psychosis.

Douglas was the second child of a middle-aged couple. His older brother had died at six years several years before the birth of Douglas. Both his father and mother were ambitious, conscientious people, eager to pull themselves into a higher economic strata than that into which they were born. The father s business kept him away from home much of the time so that his contact with the boy was slight. When with Douglas he was given to quizzing him on his school progress and to delivering moralistic talks on the virtue of hard work, courage and good sportmanship. He advised his son not to waste time on idle play and he tried to institute a Spartan regime as a preparation for the struggle to climb the ladder of success.

The boy's mother was an independent, self-reliant person, active in community affairs. She was an efficient and meticulous housekeeper and managed to supplement the family income by selling home-made bread, cakes and pies to a local restaurant. Before her marriage she had had some nurse's training and she considered herself an authority on the upbringing of children. She read a great deal and, whenever possible, took courses on home management and child care. Douglas' infancy was strictly aseptic. He was fed stipulated quantities by the clock. When he sucked his thumb his elbows were put in splint to keep his hands away from his mouth. He was trained in toilet habits before the age of 18 months and his infantile masturbation was promptly checked. As Douglas grew older he was an unusually amenable, passive child. His only striving was to please his parents who were so rigid in their demands on him. By the time he reached school he had need of perfection in himself in order to be free from anxiety and tension. But his personality growth was inhibited by the strict regime instituted by his love objects and carried on in him by his intolerant conscience.

It is the difficult task of parents, nurses and teachers to allow and, at the same time, forbid so that instinctual impulses are neither allowed too full expression or too complete denial. Mental health and mature adjustment are to be reached by a path midway between allowing and forbidding. Our aim for the unsocial, instinctual impulses is that they should be sublimated into creative or useful activity. Let us consider an example of this process of sublimation which is so important and satisfactory a means of meeting the demands of the environment without giving up the possibility of gratification of instinctual demands.

Case #4.

Jerry is a 12-year-old boy of average intelligence and of a relatively pleasing personality. He is a hard worker and, if interested in what he is doing, he works with concentration and enthusiasm. His outstanding interest is in things that are mechanical. Although he has no mathematical ability or particular manual skill, he is fascinated by engines, appliances and machinery. He takes a keen delight, not only in taking things apart but also in putting them together again so that they will work. "I like to know how things work the way they do and when I build something it works - it isn't just for looks." Jerry was willing to go to no end of trouble to find out how things were built, how they worked and how to build them himself. His room was more of a shop than a bedroom. It contained a model railroad system, a model airport, bridges that would bear weight and derricks that would lift loads. His homemade radio was the delight of his heart. Jerry's stepfather owned a second-hand car and Jerry missed no opportunity of tinkering with it. His activity with it, when his stepfather first got it, was largely of a destructive sort but his stepfather, a man of wisdom, patience and some mechanical ability himself, helped and encouraged Jerry in putting it together better than it was before. His stepfather took pains to teach Jerry to drive the car and promised him the use of it "as soon as the law allows".

Jerry was an only child whose father died shortly after his birth. When he was 4 his mother remarried and within the next year she had two miscarriages. During the interval between his father's death and his mother's second marriage, Jerry slept in a cot in his mother's room. When the stepfather entered the home Jerry was given a room of his own and his mother and stepfather slept together. For almost two years after the mother's marriage Jerry showed temper tantrums and outbursts of aggressive destructive behavior. He showed a tendency to rummage through drawers and boxes and there were scattered episodes of stealing. His mother complained at that time of his tendency to "snoop around". He was a trial to everyone because of his constant and repetitive asking of silly questions, many of which he knew the answers to.

Jerry's psychological situation following his mother's marriage was a difficult one. To him his stepfather represented a dangerous intruder who not only interfered with his own relationship to his mother but even, it seemed to him, hurt his mother and made her bleed. He did not know what went on in the bedroom from which he was carefully excluded but he was consumed with curiosity and apprehension about it.

When Jerry was 5 his mother in desperation sent him to kindergarten. From the beginning he liked it and his teacher was really fond of him, in spite of the difficulties he presented. At kindergarten he was allowed to build block towers, knock them down and build them again. He was allowed to explore the cupboards in which materials were kept and his teacher encouraged him and taught him to use whatever caught his interest. He worked with clay and paint and finally with wood and tools.

Jerry's stepfather, a big, robust man who was an expert carpenter, became as time went on not only an object of fear but also of envy and admiration. His instinctive handling of the boy was wise and Jerry, in order to hold his mother's love and win his stepfather's admiration, gradually gave up his anti-social tendencies. His mechanical interests now are not only evidences of his old identification with his stepfather but are also sublimations. In his curiosity as to how things work he can inquire into and find satisfaction for what, earlier in life, had been forbidden sexual curiosity. In taking machinery apart he can satisfy his old hostile and destructive longings. In building things that will work he can assure himself that he, too, will someday be strong and powerful, like his stepfather. Jerry's sublimations have absorbed the energy that might, under less fortunate home and school circumstances, have produced unhappy, delinquent behavior.

It is, first of all, the parents who provide the motivation for this sublimation because of the child's love relationships within his family circle. The nursery school and kindergarten provide a stage where the child in a secure, protected environment can try himself out apart from the people to whom he is so closely tied emotionally and with whom he is in such conflict. In the nursery school, for the first time, he meets life standing on his own two feet. He, of course, brings to school with him his conflicts from at home but here he can for a while try to work them out undisturbed by the objects of his love, fear and envy. The nursery school and kindergarten offer to the child materials and further incentive for the attainment of the sublimation motivated at home. It gives sympathetic help to the child's acquiring of skills into which his energy can flow. It brings new people into his horizon so that his intense feelings towards the people at home can be somewhat mitigated by interests in the large community.

This account of the stormy evolution of the child into a social being which occurs during his first 6 years does not answer individual questions of what to do about particular problems but to answer such individual questions one must know both the child and the parents and the whole life situation to which the child has had to adjust.

Present day parents and teachers bombarded by all sorts of modern, child-training literature and speeches, are apt to become panicky. Parents are told repeatedly that they are responsible for their children's future mental health

and their first impulse is to do something about it. In their eagerness to be good parents they feel that they must be active to combat the dangers that may lie in wait for their children or, following the ideas laid down by Rousseau, they avoid all prohibition, all authority, for fear they may limit their children's individual development. In either case they become self-conscious, doubting parents or self-conscious teachers but the child in his own uncertainty and doubt has need of love objects with whom to identify, who have assurance and firmness in their philosophy and a tolerance born of a happy solution of their own infantile conflicts.

CHANGES IN THE STATURE AND SITTING HEIGHT OF PRESCHOOL CHILDREN IN RELATION TO REST IN THE RECUMBENT POSITION AND ACTIVITY FOLLOWING REST

JANET E. REDFIELD AND HOWARD V. MEREDITH[1]

The study to be reported in this paper had its setting in a practical question of laboratory procedure. The question was: Does an afternoon rest period elicit a change in the stature and sitting height of children of preschool age which is sufficient to necessitate that repeated measurements of the same children at bimonthly or quarterly intervals be made with direct reference to the rest period? In other words, are there changes brought about by rest in the recumbent position which are great enough to affect the comparability of seriatim measurements on a given child where examinations are made before the rest period on some occasions, immediately after the rest period on other occasions, and at various times during the first hour following the termination of the rest period on still other occasions?

The specific aims of the study may be listed as follows:

1. To determine whether children of preschool age show significant gains in stature and sitting height during an afternoon rest period
2. To investigate the amount of loss in stature and sitting height which takes place during the first one-half hour and first hour after the rest period
3. To study gain in stature and sitting height during rest (if appreciable gain is found to occur) in relation to duration of rest period and degree of relaxation
4. To determine if loss in stature during the first hour following rest is greater under vigorous physical activity than under slight or moderate activity

LITERATURE

It has long been known that stature, and certain other linear dimensions that may be considered segments of stature, are subject to diurnal fluctuation. The research literature on this phenomenon dates back more than one and a half centuries and includes studies by Montbeillard (5, 8), Merkel (1), Bradford (2), Malling-Hanson (5), Wiener (1), Curtiss (3), Yamada (1), Poniatowski (1), Bachman (1), Hohlfeld (1), Palmer (6, 7), and Davenport, Steggerda, and Drager (4).

In 1776 Montbeillard secured measurements on his seventeen-year-old son and found that "stature tends to decrease during the day and with prolonged exertion, and that this loss is regained with rest." (8, p. 333) He is reputed to have observed that on one occasion of unusually prolonged exertion and assumption of the erect position, "when his son had danced all night,...height had decreased by 38 mm. but after 24 hours' rest the loss was recovered."(5, p.2)

"Merkel (1881) measured his own daily linear reduction in both the sitting and erect posture from the time of rising in the morning until going to bed. He had an apparatus constructed whereby he measured the height of the visual plane from the floor, the 'Augenhöhe.' His sample day, after being up six hours, showed a decrease in 'Augenhöhe' while standing of 2.0 cm. and, while sitting, of 1.6 cm. Of this decrease 0.8 cm. and 0.6 cm., respectively, or

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about one-half, took place in the first hour. After a two-hour period of rest reclining, there was a partial return toward the morning reading of about 1 cm. in both measurements, with a subsequent decrease comparable to that seen in the morning." (1, p. 394-395)

Bradford (1883) measured the stature of a single adult, aged thirty-five years, in both the erect and recumbent positions. Measurements were obtained at 7 a.m. and at 10 p.m. The findings were similar for both positions. To quote Bradford directly: "...the height of the same individual is greater in the morning than in the evening....A person is larger in the recumbent position in the morning than in the same position at night." (2, p. 246)

Malling-Hanson (1886) published a study based on approximately seventy boys of school age measured daily over a period of two years. The study incorporated the following finding on daily variation in stature: "...from the time the boys got up in the morning till the time they went to bed at night their height declined by about 1 cm., which loss was regained by the next morning." (5, p. 5)

Wiener (1896) investigated "daily decrease in height for two of his four sons." (1, p. 395) His tables show "a decrease of 0.8 and 0.9 cm. in the first hour, a partial return after a nap, and a total daily loss of 1.3 and 1.9 cm." (1, p. 395)

Curtiss (1898) made a study of change in stature during sleep using three male students (aged seventeen, nineteen, and twenty-one years) in attendance at Purdue University. The subjects were measured "just before going to bed at night and as soon as they got up in the morning, the hours being approximately 10 p.m. and 6:30 a.m." (3, p. 270) Daily records were obtained for a period of approximately six months, i.e. January through June. For the subject aged seventeen years, the average gain in stature during sleep was 16.4 mm., and the range in gain from 9 mm. to 24 mm. The findings for the other two subjects were similar. Thus, "The total average gain in height for all three was 18.22 mm." (3, p. 273) Supplementary mention was made of the fact that all three subjects took regular gymnasium work and that "On the days when they had worked especially hard in the gymnasium or field it was noticed that...the gain in height was somewhat greater." (3, p. 271) Curtiss recommended that anthropometrists note the hour at which individuals are examined and arrange for subsequent examinations "at the same hour, or as near it as possible." (3, p. 273)

The studies by Yamada, Poniatowski, Bachman, and Hohlfeld have been reviewed by Boyd (1). As for the studies by Merkel and by Weiner, it will suffice to reproduce her treatment.

"Yamada (1902) noted a daily decrease in stature in the Japanese. The available references are ambiguous as to amount.

"Poniatowski (1911) states that a daily decrease in body length of 2 to 3 cm. is well known and '...so scheint es zwecklos, die Korpergrosse genauer als bis auf ±0.5 cm. zu messen.'

"Bachman (1924), in an extensive statistical analysis of the daily shrinkage in standing height for 200 men, finds a decrease of 0.76 cm. one hour after rising, 1.77 cm. four hours after rising, 2.17 cm. seven hours after rising, and 2.36 cm. eleven hours after rising. He has also developed analytical expressions for both the daily decrease in stature and the nightly recovery.

"Hohlfeld (1928) noted that infants from six to thirteen months of age showed an average decrease in body length of 0.85 cm. after sitting up one hour, and 1.12 cm. after standing one hour. One infant, measured after sitting up two and one-half hours, showed only a 0.03 cm. decrease in the second hour." (1, p. 395)

Palmer (1930) obtained stature measurements on three preschool children at approximately hourly intervals during the day for a period of from three

to five consecutive days. He found that during the first hour after arising stature decreased approximately 7.0 mm., during the second hour approximately 3.5 mm., during the third hour approximately 2.5 mm., and during the fourth hour approximately 2.0 mm. Beyond this average reduction of about 1.5 cm. for the first four hours after assumption of the erect position, he found children "two to five years old" to "decrease about 2 cm. in standing height from morning to night...." (1, p. 396)

In addition to the above data on the general trend of daily decrease, Palmer reported incidental findings on the rate of reduction in relation to physical activity, and on increase in stature accompanying a midafternoon nap. His published treatment of these two problems, unfortunately, is restricted to the following statements: "Children who exercise vigorously in the first hour after arising may lose one-half inch in total stature. Children who have a mid-afternoon nap gain back about half the height lost during the earlier part of the day." (7, p. 3)

It is Palmer's view that loss in stature "is associated definitely with the assumption of the erect posture" and regain in stature "is associated with rest in the recumbent position." (7, p. 3) He further mentions the probability that "variations in the thickness of the intervertebral discs and in the apposition of the bones of the leg and foot account for the major part of the diurnal variation." (7, p. c)

Davenport, Steggerda, and Drager (1934) reported a study of reduction in linear dimensions of the body from morning to afternoon. One anthropometrist (M.S.) measured a single subject "fifty consecutive times at different times of the day through a number of days." (4, p. 266) Measurements of stature, supersternale height, sitting height, and sitting supersternale height were taken. The measurements "were all made from 2 to 8 hours after rising in the morning...." (4, p. 271) They were grouped into a.m. observations and p.m. observations. The two groups represented an interval of "probably not more than 6 hours...." (4, p. 271) It was found that the average loss from morning to afternoon was 7.4 mm. for stature, 6.5 mm. for supersternale height, 9.2 mm. for sitting height, and 7.6 mm. for sitting supersternale height. In discussing the findings for stature and sitting height the authors state, "It might seem remarkable that the loss should be the greater in the sitting height (involved as it is in stature). But anyone who has had extensive experience in measuring sitting height knows that the act of sitting, as contrasted with standing, brings quite new muscles to play upon the posture of the trunk and demands special control of, and tone in, those muscles. For we are habituated to erect standing and to a slumping sitting posture. The loss of stature during the day is probably quite as much due to loss of 'tone' as of thickness of intervertebral pads." (4, p. 270-271)

SUBJECTS

The subjects for the present study were twenty-two children between four and five years of age. They were all of the children in attendance at Group III of the Iowa Child Welfare Research Station preschools during the spring months of 1938. This group met between one and five o'clock in the afternoon.

In accordance with the program being followed in the group, half of the children rested between the hours of one and three o'clock and the other half between the hours of three and about four-thirty. For purposes of this study it was possible to examine the children of the former group four times in the course of the afternoon and the children of the latter group twice. Specifically, the children of the group that rested from one to three o'clock were examined

just before going to the sleeping room, immediately upon rising, one-half hour later, and one hour after rising. The children in the second group were examined just before going to rest and immediately upon rising.

MEASUREMENT PROCEDURE

Determinations of stature and sitting height were made by the following anthropometric technique:

Stature

Instrument: Baldwin Paper Measuring Scale and Square

Definition of Measurement: Erect body length from the soles of the feet to the vertex

Landmark: Vertex -- the highest point of the head when held with the tragion-orbitale plane parallel to the floor

Posture: The subject stood erect with heels almost touching each other. Heels, buttocks, upper part of back and rear of head were in contact with the wall to which the scale was attached. The arms were permitted to hang at the sides in a natural manner.

Technique: When the subject was in position, the anthropometrist took the square and placed it above the subject's head so that its one face was against the scale and its other face horizontal with the floor. The square was then brought down until the horizontal face crushed the subject's hair and made firm contact with the vertex. Care was taken to see that the subject kept his heels in firm contact with the floor.

Sitting Height

Instrument: Baldwin Paper Measuring Scale, Square, and a horizontal walnut bench 30 cms. in height

Definition of Measurement: Distance from the surface of the bench to the vertex with the subject in an erect sitting position

Posture: The subject sat on the bench with his knees flexed and spread apart, his ankles crossed, hands resting on his thighs, and the posterior aspect of his trunk in contact with the scale both at the sacral region and at the upper thoracic region. Always after the knees of the subject had been spread apart and his ankles crossed (in order to release as much as possible the tension of the gluteal muscles and to permit the ischia closely to approximate contact with the bench) the anthropometrist checked to see that the sacral region was in contact with the scale.

Technique: The Square was brought down firmly on the vertex as in measurement of stature, and the sitting height recorded as the value read from the scale minus the height of the bench.

Each time a child was examined three independent measurements each for stature and sitting height were obtained. In the case of stature, for example, after the first reading was taken the child was removed from his position in front of the scale and entirely replaced for a second reading. He was then again removed and replaced for a third reading. The median of the three readings was taken as the stature record for the examination. A sitting height value for each examination was obtained in the same manner.

Three or four children from each rest group, making a total of seven or eight in all, were as many as could conveniently be measured in any one after-

noon.[2] Consequently, collection of the data covered a number of days.

Because of the limited number of subjects available, from one to four series of observations were made on each child. No selective factors, other than that of availability on the days that collection of the data was in progress, operated to restrict a few children to one series of observations while a few others received four series of observations.

GAIN DURING REST

A total of forty-five examinations were made just prior to rest and again immediately following rest. These examinations made it possible to compute, for each of forty-five cases, the difference between stature before rest and stature after rest and the difference between sitting height before and after rest.

Forty-five cases were accumulated by using all of the twenty-two subjects once, fifteen of the subjects twice, six of the subjects three times, and two of the subjects four times. The duration of the rest period ranged from one to two and one-half hours, with most of the subjects resting about one and three-fourths hours. Rest took place in an appropriately equipped sleeping room with the child recumbent on a bed.

The two series of differences were computed as stature after rest minus stature before rest, and sitting height after rest minus sitting height before rest. Consequently, positive values were indicative of gains during rest. Distribution and analysis of the differences obtained, specific for each measurement, gave the following tabulation.

Statute			Sitting Height		
Gain, Millimeters	Number	Per Cent	Gain, Millimeters	Number	Per Cent
0 to 2	2	4.4	- 4 to - 1	5	11.1
3 to 5	6	13.3	0 to 3	5	11.1
6 to 8	12	26.7	4 to 7	14	31.1
9 to 11	12	26.7	8 to 11	13	28.9
12 to 14	9	20.0	12 to 15	4	8.9
15 to 17	1	2.2	16 to 19	2	4.4
18 to 20	2	4.4	20 to 23	2	4.4
21 to 23	1	2.2			
Total	45	99.9		45	99.9
Mean gain = 9.3 mm.			Mean gain = 7.7 mm.		
Range = 0 to 21 mm.			Range = -4 to 23 mm.		

The findings from this tabulation are:

1. The mean gain in stature of four-year-old children during an afternoon rest period of approximately one and three-fourths hours duration is 9.3 mm. The corresponding mean gain found for sitting height is 7.7 mm., or 83 per cent of that for stature.
2. Eighty-two per cent of the cases show stature gains greater than 5 mm., or one-fifth inch. Sitting height gains of 4 mm. and higher are obtained for 78 per cent of the cases.
3. The range for stature is from no gain in one instance to a gain of 21 mm. The child showing a gain of 21 mm. served as a

[2]The writers wish to acknowledge their gratitude to Miss Eleanor Lack, head teacher of Group III, for her interest in the study, for the splendid manner in which she introduced the study to the children, and for her cooperation in facilitating collection of the data.

subject two other days. On all three occasions the rest period approximated two hours and the child was asleep for somewhat more than one hour. The gains on the other days were 10 mm. and 8 mm., respectively. The child showing no gain served as a subject on one other day. The gain on this second occasion was 7 mm. On neither occasion did the child sleep. The gain of 7 mm. was associated with a rest period of one and one-half hours duration. The "no gain" record was obtained for a rest period of one hour, during which the child was observed to be exceptionally restless.

4. For sitting height the range is from a loss of 4 mm. to a gain of 23 mm. The greater variability of the findings here is undoubtedly due to the relative unreliability of sitting height measurements.

GAIN DURING REST IN RELATION TO SLEEP

In order to obtain an indication of the influence of "degree of relaxation and duration of rest period" on the gain in stature and sitting height during rest, the data presented in the previous section were subdivided. The subdivision was made on the basis of whether the cases did or did not sleep -- the assumption being that the degree of relaxation is greater for a group of children who sleep during rest than for a group who do not sleep. As one would expect, the cases that slept tended to have longer rest periods than those staying awake. Specifically, the mean duration of the rest period was 2 hours, 5 minutes for the sleep group and 1 hour, 20 minutes for the nonsleep group. The range in duration was from 1-1/2 hours to 2-1/2 hours for the former group and from 1 to 2 hours for the latter group.

Twenty-seven of the forty-five cases fell in the sleep group and the remaining eighteen in the nonsleep group. The amount of sleep per case for the members of the sleep group varied between 1 hour and 1-3/4 hours. Statistical reduction of the data for each group paralleled that for the total cases reported above. The following tabulation gives the results.

Gain, Millimeters	Sleep Group Number	Sleep Group Per Cent	Nonsleep Group Number	Nonsleep Group Per Cent
Stature				
0 to 2			2	11.2
3 to 5	1	3.7	5	27.8
6 to 8	4	14.8	8	44.4
9 to 11	9	33.3	3	16.7
12 to 14	9	33.3		
15 to 17	1	3.7		
18 to 20	2	7.4		
21 to 23	1	3.7		
Total	27	99.9	18	100.1
Mean gain = 11.7 mm. Range = 5 to 21 mm.			Mean gain = 5.7 mm. Range = 0 to 10 mm.	
Sitting Height				
- 4 to - 1			5	27.8
0 to 3	3	11.1	2	11.1
4 to 7	6	22.2	6	33.3
8 to 11	8	29.6	4	22.2
12 to 15	6	22.2	1	5.6
16 to 19	2	7.4		
20 to 23	2	7.4		
Total	27	99.9	18	100.0
Mean gain = 10.1 mm. Range = 0 to 23 mm.			Mean gain = 4.2 mm. Range = -4 to 13 mm.	

It is found that for children four years of age:

1. The mean gain in stature during an afternoon rest period of two hours duration, where the children spend roughly one and one-fourth of the two hours in sleep, is 11.7 mm. or, practically, one-half inch. The corresponding mean gain for sitting height is 10.1 mm., or 86 per cent of that for stature.
2. The mean gain in stature for the nonsleep group (i.e., group having a rest period of approximately one and one-fourth hours though not sleeping) is 5.7 mm., or less than one-half that of the sleep group. Likewise the mean gain in sitting height for the nonsleep group is less than one-half that for the sleep group.
3. Over 80 per cent of the cases in the sleep group show stature gains in excess of 8 mm., or one-third of an inch. In contrast, a similar percentage of the cases in the nonsleep group show stature gains of less than a third of an inch.
4. Sitting height gains of 8 mm. or more are obtained for approximately 67 per cent of the sleep group and 28 per cent of the nonsleep group.
5. For stature, the range is from zero gain to a gain of 10 mm. in the case of the nonsleep group, and, in the case of the sleep group, from a gain of 5 mm. to a gain of 21 mm. For sitting height, the range of the nonsleep group is from a loss of 4 mm. to a gain of 13 mm., while the range of the sleep group is from zero gain to a gain of 23 mm.

LOSS DURING FIRST HOUR FOLLOWING REST

For the subjects resting between approximately one and three o'clock, it was possible to make two series of examinations subsequent to that made immediately following rest. Consequently, twenty-two cases (involving ten different subjects) were examined at thirty minutes, and again at one hour, after the rest period. All twenty-two cases slept during rest. The mean duration of the rest period was roughly 2 hours, and the mean duration of sleep 1-1/4 hours.

With the aid of these data and the data obtained immediately following rest, differences for each case were calculated between stature after rest and stature one-half hour later, sitting height after rest and sitting height one-half hour later, stature after rest and stature one hour later, and sitting height after rest and sitting height one hour later.

The two series of differences analyzed in the following tabulation were computed as stature immediately after rest minus stature one hour later, and sitting height immediately after rest minus sitting height one hour later.

Stature			Sitting Height		
Loss, Millimeters	Number	Per Cent	Loss, Millimeters	Number	Per Cent
0 to 2	1	4.5	-12 to - 9	1	4.5
3 to 5	2	9.1	- 8 to - 5		
6 to 8	8	36.4	- 4 to - 1	1	4.5
9 to 11	4	18.2	0 to 3	4	18.2
12 to 14	6	27.3	4 to 7	7	31.8
15 to 17	1	4.5	8 to 11	3	13.7
			12 to 15	3	13.7
			16 to 19	2	9.1
			20 to 23	1	4.5
Total	22	100.0		22	100.0
Mean loss = 8.2 mm. Range = 1 to 15 mm.			Mean loss = 6.8 mm. Range = -10 to 20 mm.		

This tabulation yields the following findings:

1. Mean loss in stature of four-year-old children during the first hour following an afternoon rest period of approximately two hours duration is 8.2 mm. The concomitant mean loss in sitting height is 6.8 mm., or 83 per cent of the loss for stature.
2. Eighty-six per cent of the cases show losses in stature greater than 5 mm., or one-fifth of an inch. Sitting height losses of 4 mm. or higher are obtained for 73 per cent of the cases.
3. The range of loss in stature is from 1 to 15 mm. For sitting height, the corresponding range extends from a gain of 10 mm. to a loss of 20 mm.
4. The mean loss in stature during the first hour following rest (8.2 mm.) is equivalent to 70 per cent of the mean gain obtained during rest for the sleep group (11.7 mm.).

Analysis of the data on loss in stature and sitting height during the first one-half hour following rest gave means of 5.4 mm. and 4.4 mm., respectively. In relation to mean loss for the first hour, these figures imply that in the case of stature 66 per cent of the loss occurs between the termination of rest and thirty minutes later, while in the case of sitting height the loss for one-half hour is 57 per cent of that for one hour.

LOSS FOLLOWING REST IN RELATION TO ACTIVITY

An attempt was made to investigate the influence of the type of activity in which a child engages during the first hour after rest upon the amount of loss in stature for the same interval. The cases employed were the same as in the previous section. Prior to reporting the findings, it is pertinent (1) to give a brief description of the preschool program being followed at the time of the study and (2) to define the activity categories employed.

The early part of the post-rest program was standard for all children. Approximately the first fifteen or twenty minute period after rising was occupied by the routines of toileting and lunch. Choice among several activities was then available, varying from day to day. Those in which the cases of the present study were engaged on the days they were observed were classified into three groups according to an estimate of the amount of bodily activity expended. The groups were designated "slight activity," "moderate activity," and "vigorous activity."

Under the category of slight activity were included such occupations as listening to music or stories; painting, pasting, or coloring while seated at a table; and block building with small blocks while seated on the floor. Moderate activities covered such types of motion as walking about, standing, and reaching; painting at an easel; water play at an indoor tank; clay modeling; and block building involving moderate activity. Vigorous activities were those requiring strenuous movements of the whole body: marching; block building with large blocks accompanied by running, pushing, hauling, and carrying; and outdoor play on trapeze, rings and horizontal bar, or running, jumping, and similar activities.

The findings for each of the twenty-two cases employed are shown in the tabulation on the following page.

Case	Gain During Rest	Loss During First Hour	Percentage of Gain Lost
		Slight Activity	
1	11	1	9
2	11	5	45
3	13	6	46
4	12	7	58
5	10	6	60
6	11	7	64
7	9	6	67
8	12	12	100
		Moderate Activity	
9	21	9	43
10	11	7	64
11	14	10	71
12	18	13	72
13	5	4	80
14	10	9	90
15	7	13	186
		Vigorous Activity	
16	14	12	86
17	10	9	90
18	7	7	100
19	8	8	100
20	12	12	100
21	15	15	100
22	8	12	150

Selected findings indicated are:

1. Seven of the eight cases in the slight activity group show a loss during the first hour of less than 70 per cent of the gain during rest. In contrast, all of the cases in the vigorous activity group show a loss of more than 80 per cent of the gain during rest.
2. Five of the eight cases in the slight activity group show loss during the first hour of 60 per cent or less of the gain during rest. Percentages of gain lost fall between 64 and 90 for five of the seven cases in the moderate activity group and above 90 for five of the seven cases in the vigorous activity group.

SUMMARY AND CONCLUSIONS

Changes in the stature and sitting height of four-year-old preschool children are studied in relation to an afternoon rest in the recumbent position and in relation to physical activity during the first hour following the rest period.

For the total cases studied, it is found that during a rest period of approximately one and three-fourth hours duration there occurs a mean increase of 9.3 mm. for stature and 7.7 mm. for sitting height. For cases who rested roughly two hours and who slept more than one-half of this time, a mean gain is obtained of 11.7 mm. for stature and 10.1 mm. for sitting height.

In the case of the subjects who rested two hours and were asleep about one and one-fourth hours, a mean loss in stature and sitting height is found during the first hour after rest. This loss is equivalent to 70 per cent and 67 per cent of the mean gain during rest for stature and sitting height, respectively.

On the whole, the losses obtained in stature during the first hour following rest are greater for cases observed to engage in vigorous physical activities than for those occupied at relatively nonstrenuous tasks.

The findings are considered to warrant two conclusions: first, that the changes in stature and sitting height of four-year-old children associated with an afternoon rest period are appreciable -- the mean gain under conditions of rest with sleep is found to be equal to two months growth for children of this age; and, secondly, that the changes are sufficiently marked to necessitate that repeated measurements of stature and sitting height on the same children at bimonthly or quarterly intervals should be made with direct reference to the rest period, e.g., if a child is given his initial examination before rest he should be examined before rest on successive occasions.

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THE MENTAL DEVELOPMENT OF ADOPTED CHILDREN WHOSE TRUE MOTHERS ARE FEEBLE-MINDED

MARIE SKODAK[1]

Among the numerous questions in the field of mental deficiency, one in particular has practical implications for child welfare. It runs something like this, "Since mentally deficient girls are such notorious sources of illegitimate children, what policy ought to be adopted with reference to these children? Are they doomed to feeble-mindedness and life-long institutional care? Or can they be placed in normal adoptive homes with reasonable expectation that they will develop into normal children?"

The experimental evidence which should form the basis of a reply to this question consists of the placement of young infants of known feeble-minded parentage in normal, average homes where they will grow up as integral members of the family. Such experiments are probably not infrequent in the placement of children for adoption. However, the combination of definite information on the parentage and on the mental development of the child is rare. It happens that this information is available on the progress of a group of such children so placed in Iowa. Since the first results of the larger program, of which this study is a part, have been made available elsewhere (2), only brief references to the general results will be made.

Through the co-operation of the Iowa Child Welfare Research Station, the Iowa State Board of Control, and the Iowa Children's Home Society, a program for the study of the mental development of foster children has been underway for the past four years. At the present time special attention is being focused on the study of the mental development of those children who were placed in adoptive homes under the age of six months. Since the mean age at placement was approximately three months, the children were placed in their permanent homes without having experienced the environmental influences of their true mothers' homes.

Out of a total group of 154 children placed under the age of six months, whose mothers ranged from feeble-minded to superior in intelligence, it was possible to select sixteen children whose mothers were definitely known to be feeble-minded, not only on the basis of intelligence test scores but also on the basis of qualitative diagnoses by the examiners, school and occupational histories, and social adjustment. Recommendation for institutional care or very close social supervision had been made in all these cases.

That this group of sixteen is definitely selected for inferiority of true parents is evident when the group is compared to the total group of 154 foster children, as shown in Table 1.

TABLE 1

	Children of Feeble-Minded Mothers			Total Group of Foster Children		
	Number	Mean	S.D.	Number	Mean	S.D.
Mothers' IQ	16	66.4	6.3	80	87.7	15.8
Mothers' education	15	7.6	1.2	144	9.9	2.2
Fathers' education	7	9.0	1.8	88	10.2	2.5
Fathers' occupational classification	10	6.3	..8	110	5.4	1.8

[1]From Iowa Child Welfare Research Station, State University of Iowa, Iowa City, Iowa.

The mean IQ of the sixteen mothers is 66.6 with a range from 54 to 74. The mean IQ of eighty mothers of the total group for whom this information is available is 87.7 with a range from 54 to 128. These results are based on the 1916 revision of the Stanford-Binet given by qualified psychologists. The results of the examinations were substantiated by qualitative observations of the behavior and adjustment of the individuals both at time of examination and as judged from the case histories.

The mean education of the mothers of the selected group is 7.6 grades completed with no mother reporting attendance beyond the eleventh grade. The mean education of the mothers of the total group is 9.9 grades and covers the academic range to fourth year in college. The reported education of the mothers is higher than that usually predicted for individuals of this mental level. By no means, however, does it represent the actual achievement in school. The evidence from social histories and school records indicates that the group was markedly over age for grade, and had done consistently inferior school work. The mothers, at least, belong to that group of school problem children who, lacking opportunity for special education or suitable vocational placement and held by compulsory education laws, are tolerantly passed from grade to grade on the basis of age and physical maturity rather than academic progress.

In the absence of intelligence test results for the fathers, their mental level may be inferred from their education and their occupational classification. The fathers of the selected group completed a mean of 9 grades. One father had completed high school and had had one semester beyond that. The fathers of the total group had completed a mean of 10.2 grades and ranged in education through four years of college. Comparison of the occupations of the fathers whose education is known with those whose education is unknown showed no difference between the two groups and it was concluded that the former may be considered representative of the educational level of the entire group.

The occupational classification used in this study is that devised by Goodenough (1) and based on the occupational classification of employed males in the United States. Group I represents the professional occupations, Group II the semiprofessional and managerial, Group III the clerical and skilled trades, Group IV the farmers, Group V semiskilled occupations, Group VI slightly skilled trades or other occupations requiring little training or ability, and Group VII unskilled laborers of all types. According to such a classification the true fathers of the selected group have a mean of 6.3, which falls between the unskilled and very slightly skilled categories. The fathers of the entire group of foster children have a mean occupational classification of 5.4, while the mean for the entire United States, based on the distribution of the 1930 census is 4.8. Only two fathers of the children of feeble-minded mothers were reported in occupations as high as Group V and these were a cobbler and a grocery store clerk. Eighty per cent of the fathers of the selected group were in the lower two occupational classes, as compared to 57.3 per cent for the total group and 30.8 per cent for the population as a whole.

The families of the sixteen children are distinguished for long records in welfare offices even during predepression years and for familiarity with various state and local penal, mental hygiene, and charitable institutions. Judging from these facts and from the general tenor of the material in the case folders, the examination of the children was preceded by apprehension that they would be markedly inferior in intelligence to the level of the foster families.

All the foster parents are highly selected on qualitative bases since references, social standing in the community, and similar factors are carefully scrutinized before a child is placed in the home. However, comparison of the two groups of foster parents in Table 2 shows that there was a slight tendency toward selective placement.

The mean education of the foster parents of the selected group is 10.8

TABLE 2

	Children of Feeble-Minded Mothers			Total Group of Foster Children		
	Number	Mean	S.D.	Number	Mean	S.D.
Mothers' education	16	10.6	2.6	152	12.0	2.7
Fathers' education	16	10.8	3.4	153	12.0	3.8
Fathers' occupational classification	16	3.8	1.8	154	3.1	1.4

grades for the fathers and 10.6 grades for the mothers, while the mean for the foster fathers and mothers of the total group is 12 grades completed. The distribution of the proportions of the foster parents who have completed varying amounts of education, shown in Table 3, confirms the evidence for some selection in the placement of these children, but also emphasizes the fact that the number and the proportion of those foster parents whose education was limited to the elementary grades is very small.

The mean occupational classification of the sixteen foster fathers is 3.8, while the mean for the total group is 3.1. These are both well above the mean of 4.8 for the population as a whole.

Thus there is a group of sixteen children, whose true-family history is extremely poor, who have at least one parent known to be feeble-minded, but who were placed at a very early age in foster homes above the average of the general population from the standpoint of occupation and social status. It is possible to compare the mental development of these children with that of a larger group of adopted children whose true-family history, while inferior to that of the population as a whole, is not as extreme in its deviation. Both groups of children have experienced essentially only the environment of the adoptive homes and the foster homes of the children of known mentally defective mothers do not differ significantly from those of the group as a whole.

All the children were given at least two intelligence tests during the course of this study. The first, given at the time of application for the completion of adoption and following at least one year of residence in the foster home, was given at a mean age of two years, one month for the total group. The second examination, given after an interval of one to three years, was given at a mean age of four years, four months for the total group. Ages at the time of first examination ranged from one to seven years, and at time of last examination from two to ten years for the entire group. At the time of first examination the selected group had a mean chronological age of two years, six months with a range from one to five years, and on second examination a mean age of five years with a range from two to seven. Throughout

TABLE 3

	Foster Parents of Children of Feeble-Minded Mothers		Foster Parents of Total Group of Children	
	Fathers	Mothers	Fathers	Mothers
Beyond high school	25.0	31.3	39.2	39.5
High school (9 to 12)	31.3	37.5	34.0	44.0
8th grade completed	31.3	25.0	24.8	12.5
Less than 8th grade	12.5	6.3	2.0	4.0

TABLE 4

INTELLIGENCE TEST RESULTS OF CHILDREN OF FEEBLE-MINDED MOTHERS COMPARED TO TOTAL GROUP OF CHILDREN PLACED UNDER SIX MONTHS OF AGE

	Children of Feeble-Minded Mothers			Total Group of Foster Children		
	Number	Mean IQ	S. D.	Number	Mean IQ	S. D.
Children Placed in All Types of Foster Homes						
First examination	16	116.4	11.6	154	116.0	13.6
Last examination	16	107.6	12.9	154	111.5	13.2
Children Placed in Foster Homes in the Three Upper Occupational Classifications						
First examination	8	118.9	11.0		116.0*	
Last examination	8	111.4	10.7		114.0*	
True mothers' IQ	8	63.9	4.9	46	89.7	16.3
Children Placed in Foster Homes in the Four Lower Occupational Classifications						
First examination	8	113.9	11.4		113.7*	
Last examination	8	103.9	13.7		104.5*	
True mothers' IQ	8	68.9	4.1	34	86.1	12.6

*Values read from smoothed curved at ages corresponding to mean age at examination of the children whose mothers are feeble-minded.

the study children under three and one-half years were given the 1922 revision of the Kuhlmann and those older were given the 1916 Stanford. The results of the examination are given in Table 4.

The mean IQ on first examination of the group of sixteen children whose mothers were known to be subnormal was 116.4. The mean for the total group of 154 children was the same. The sixteen children ranged from 95 to 131 IQ and the total group from 80 to 152, with only five children or 3 per cent of the total under 90 IQ. No child was classified as borderline or lower in intelligence.

On re-examination after an interval of one to three years, the sixteen children had a mean IQ of 107.6 with a range from 81 to 132. The mean IQ of the total group was 111.5 with a range from 81 to 149.

When the mental development of the children of feeble-minded mothers is compared to that of the total group on the basis of the type of foster home in which the children were placed, it is seen that the selected group follows the same pattern of development as the total group. The eight children of mentally defective mothers, placed in foster homes in the three upper occupational categories, on first examination at a mean age of three years, five months had a mean IQ of 118.9. Re-examined at a mean age of five years, five months, their mean IQ was 111.4. At the same ages the mean IQ's of those children of the total group who were placed in similar homes were 116 and 114. Eight children of mentally defective mothers, who were placed in foster homes in the four lower occupational categories, on first examination at a mean age of one year, eight months had a mean IQ of 113.9. On re-examination at a mean age of four years, three months these children had a mean IQ of 103.9. Children of the total group placed in similar homes and examined at the same mean ages were practically identical in mean IQ. The extent to which the curves of mental development of these two groups of children coincided, compared as total groups and according to the types of foster homes in which they were placed, is graphically shown in Figure 1.

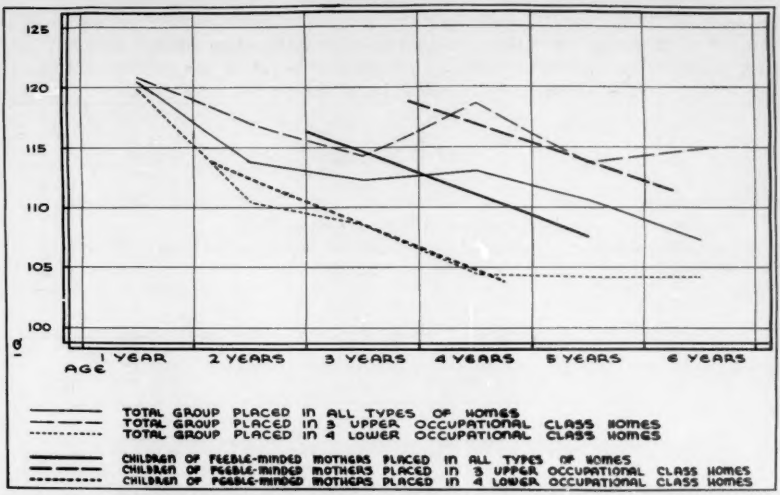

Fig. 1. Comparison Between Mental Development of Children of Feeble-Minded Mothers and Total Group of Foster Children, by Age at Test, Mean IQ and Foster Father Occupational Classification.

The differences between the intelligence levels of the mothers of the selected children as compared to the total group amounting to 26 points for children in the three upper classification homes and 17 points in the four lower classification homes, appear to have no differentiating influence on the mental development of the children. If any difference exists between the family backgrounds of the selected children who were placed in the two types of foster homes, it is in favor of the children in the lower homes. Yet their mean IQ is materially below that of the children in the better foster homes.

SUMMARY OF RESULTS AND CONCLUSIONS

While the number of cases reported here, whose mothers are known to be mentally defective, is not large, the results consistently point in the same direction. They may be summarized briefly as follows:

1. The children of feeble-minded mothers, like the entire group of adopted children placed under the age of six months, are higher in intelligence than would be expected from the true-family histories.

2. None of the children placed under six months of age, regardless of the degree of mental defect of the mother, has been found to be subnormal in intelligence and none has been found to be of borderline mental development.

3. Children of feeble-minded mothers placed in foster homes of the higher occupational levels and children of feeble-minded mothers placed in foster homes of the lower occupational levels show the same mean level of intelligence and the same developmental trends as do all children, regardless of true-family background, placed in similar homes and examined at the same mean ages.

4. There is no evidence at the present time that a sudden decline to the feeble-minded level can be anticipated for these sixteen children.

The general conclusions which may be drawn from these results are that children of feeble-minded mothers and grossly inferior true-family background, when placed in average and superior foster homes at an early age, are indistinguishable in mental development from children whose mothers are not

feeble-minded. The results indicate that if a child is physically normal and if placement is made at so early an age that the child experiences essentially only the environment of the foster home, the mental status of the mother ought to be no bar to the placement of the child in a permanent foster home.

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DEVELOPMENTAL CHANGES IN THE DISTRIBUTION OF PARTS OF SPEECH

EDITH A. DAVIS[1]

Students in the field of language are emphasizing more and more the functional approach. They are increasingly dissatisfied with the traditional classification of words into parts of speech. Since overlapping between adjective and adverb, preposition and conjunction, adverb and pronoun, even noun and verb is so great that accuracy can be secured only by treating each word according to its usage in the individual instance, Aiken (1) would go so far as to discard the old system of classification altogether and substitute six functions of speech, namely verb, subject, complement, modifier, connective, and the absolute construction. Nothing so radical is attempted in the present paper, although both by subdivision and by grouping of categories an effort is made to detect possible age and sex differences in the use of various parts of speech by children.

McCarthy (4) found that nouns make up about 50 per cent of the total speech of very young children; verbs increase in importance from about 14 per cent at 18 months to 25 per cent at 54 months; adjectives increase during the same period from about 10 to about 15 per cent, and pronouns from 10 to about 20 per cent; adverbs show little change with advancing age, interjections decrease, and connectives do not appear at all until the age of two years and thereafter increase steadily in importance. The meagre information available concerning older children (5) indicates that the proportions of parts of speech found at four years remain virtually unchanged.

In a recently completed study of samples from the speech of 436 children between the ages of 5-1/2 and 9-1/2 years (2), the writer made no systematic analysis according to parts of speech, because of this probability that further age changes would not be found. In view of the possibility that a finer subdivision of nouns, verbs, and so on might reveal certain age and sex differences, such a classification has now been made. The findings based on percentage of total words used vary hardly at all from the percentages given by McCarthy for her three highest age levels, 3-1/2, 4, and 4-1/2 years. This fact is especially significant because McCarthy had only twenty subjects at each age, whereas the writer's subjects were concentrated in large groups at three rather widely separated age levels. Table 1 compares the percentages for these older children with McCarthy's 4-1/2-year group and with the mean percentage for her three oldest age groups. The mean was computed because at these ages no consistent developmental trend can be detected. The minor variations are probably chance fluctuations due to the selection of a small number of cases at each age.

In the present analysis adjectives and adverbs were grouped under the heading of "modifiers" for two reasons. First, although children often use an adjective erroneously in place of an adverb, ("I'm awful glad you came") this distinction was not made clear on the summary sheets; second, it is possible that the use of modifiers increases with age. No such increase was found, however, and in computing the totals adjectives and adverbs not used as modifiers were simply added to the list so as to avoid making another tabulation. The total percentage of adjectives and adverbs for McCarthy's subjects of the ages considered was identical with that for the writer's 5-1/2-year-old group, but slightly higher than that for the children aged 6-1/2 and 9-1/2 years respectively. Nouns and pronouns were very slightly less important for older children than for McCarthy's subjects, while the percentage of verbs in-

[1]From the Institute of Child Welfare, University of Minnesota.

TABLE 1

MEAN PERCENTAGE OF EACH PART OF SPEECH USED BY CHILDREN OF VARIOUS AGES (BASED ON TOTAL NUMBER OF WORDS)

Type of Word	McCarthy		Zyve (5)	Davis		
	3½, 4, 4½ years Mean of 60 cases	4½ years 20 cases	Third grade	5½ years 248 cases	6½ years 63 cases	9½ years 125 cases
Nouns	19.3	19.3	15	18.5	18.4	17.5
Verbs	25.7	25.1	27	26.2	26.7	27.0
Adjectives	15.2	15.2		22.0	20.0	20.1
Adverbs	6.9	7.0				
Pronouns	20.8	20.5	17.2	19.1	19.6	17.4
Conjunctions	3.2	3.8		2.4	3.4	5.3
Prepositions	7.0	7.1		8.6	8.9	10.1
Interjections	1.3	1.2		2.0	1.4	1.3
Miscellaneous	0.8	0.8		1.4	1.7	1.3

TABLE 2

MEAN PERCENTAGE OF EACH PART OF SPEECH USED BY CHILDREN, ACCORDING TO AGE AND SEX (BASED ON NUMBER OF DIFFERENT WORDS USED)

Type of word	McCarthy		Davis					
	4½ years		5½ years		6½ years		9½ years	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Nouns	36.0	36.8	43.1	45.9	41.4	44.4	41.4	42.5
Verbs	27.8	25.5	26.9	26.0	29.9	27.7	30.3	29.8
Adjectives, adverbs	21.2	21.0	18.3	17.9	17.1	16.7	19.4	19.1
Pronouns	6.5	7.1	2.7	2.5	3.6	3.5	2.6	2.6
Conjunctions	1.2	2.4	1.3	1.3	1.7	1.7	1.3	1.4
Prepositions	3.6	3.8	2.6	2.6	3.3	3.1	2.9	2.8
Interjections	2.0	1.4	4.2	3.0	2.0	2.1	1.4	1.0
Miscellaneous	1.7	2.1	0.8	0.8	0.9	0.8	0.7	0.8

creased only from 25.7 for the young children to 27.0 at 9-1/2 years. Prepositions and conjunctions, which appear last in children's speech, increased very slightly with advancing age.

Percentages computed on the basis of different words used show somewhat greater age changes, although the findings for all groups combined are very close to those of Zyve (5) for her third-grade subjects. Table 2 compares the groups by age and sex with McCarthy's 4-1/2-year group. By the age of four years children seem to have acquired all the commonly used pronouns, prepositions, and conjunctions, so that as their vocabulary grows there can be no proportionate increase in these categories of speech. They ring the changes on a common stock of adjectives, adverbs, and irregular verbs, while the gradual mastery of a wealth of name words and regularly inflected verbs accounts for vocabulary growth.

One would suspect, therefore, that the separation of nouns and verbs into finer subdivisions would bring out some significant trends. Nouns were classified as names for human beings, names of specific persons and places (3), names of animals, names of objects, and abstract or collective nouns not included in the previous categories. Table 3 and Figure 1 give the percentage distribution of the nouns among the several categories on the basis both of total and of different words used. There is a striking similarity in pattern for both sexes and for all age groups. Children at 9-1/2 years used a higher percentage of words naming human beings than children at 5-1/2 or 6-1/2 years. Apart from proper names, 135 different nouns were used by the 436 children to refer to human beings. Such words ranged from "Indian" with 1,656 occurrences, to "millionaire," "beggar," "bandit," "herdsman," and "flag-bearer," each recorded once. They made up 3.9 per cent of the total speech of children at

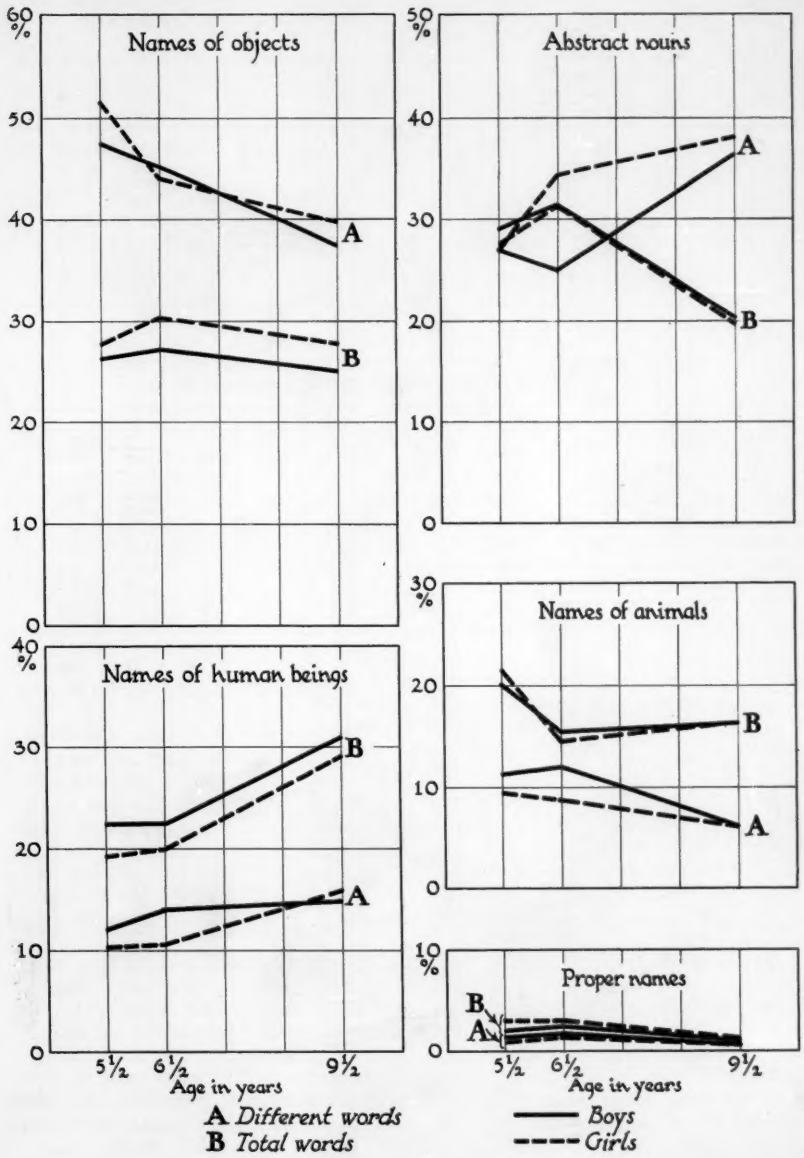

Fig. 1. Percentage distribution of different types of nouns among the several categories, for boys and for girls at various ages.

TABLE 3

PERCENTAGE DISTRIBUTION OF DIFFERENT TYPES OF NAME WORDS USED BY CHILDREN, ACCORDING TO AGE AND SEX

Age	Sex	Percentage of Total Nouns					Percentage of Different Nouns				
		Human Beings	Proper Names	Animals	Objects	Abstract Terms	Human Beings	Proper Names	Animals	Objects	Abstract Terms
5½	Boys	22.5	2.2	20.1	26.1	29.2	12.1	1.8	11.4	47.6	27.1
5½	Girls	19.5	3.2	21.6	27.9	27.7	10.5	1.7	9.4	51.7	26.6
6½	Boys	22.4	2.5	15.7	27.3	31.9	14.6	1.9	12.3	45.6	25.5
6½	Girls	20.3	3.1	14.4	30.5	31.6	10.9	1.8	8.9	44.3	34.1
9½	Boys	31.5	1.7	16.2	25.2	25.4	15.0	1.4	6.7	37.8	39.0
9½	Girls	29.4	1.4	16.3	28.0	24.9	16.3	1.4	6.0	39.8	36.5

5-1/2 years and 5.3 per cent of that of children at 9-1/2 years. At each age the percentage was slightly higher for boys than for girls.

The younger children, on the other hand, used a slightly higher percentage of names of animals. Many of the 5-1/2-year-old children were so retarded in speech that they were still at the "naming" stage of development, and such a response would naturally follow the presentation of the array of little animals used in the standardized situation set up for the purpose of obtaining the language records (2). The percentage of names of objects is relatively constant for total speech, but decreases with age when the number of different words used is the basis of computation. Girls used rather more names of objects than boys. The percentage of abstract and collective terms in total speech was actually a little lower at 9-1/2 than at 5-1/2 years, but it becomes appreciably higher when the percentage is based on the number of different terms of this kind. In other words, although the young children frequently used such nouns as "kind," "light," "matter," "plenty," and "end," the older ones used them in much greater variety, and added "danger," "direction," "pleasure," "protection," "ambush," and "dawn."

Grammarians and educators have pointed out again and again that the total frequency of the common irregular verbs is astoundingly high. Verbs used by the children in this study were classified as regular and irregular, and the irregular verbs sometimes used as auxiliaries were separated according to the percentage of such use. Regularly formed verbs accounted for only 15 per cent of the total verbs used at 5-1/2 years, and for only 19.5 per cent of those used at 9-1/2 years. Of the 80 to 85 per cent of all verb forms that are irregularly inflected, from 25 to 30 per cent are distributed among the 48 forms (including contractions with "not") used as auxiliary or helping verbs. Less than half the total usage of these 48 forms, however, is auxiliary in function. In other words, the child "has" something more often than he "has" to go somewhere or "has" made something; he is more likely to "go" somewhere than to be "going" to tell a story; and he classifies an object ("This is a horse; he is black") more often than he states that the horse "is" running. Table 4 shows that this distribution varies in turn with the different verbs. "Got" is auxiliary in only about 3 per cent of its occurrences, "can" in from 85 to 90 per cent, and "shall" and "will" in 100 per cent.

Table 4 shows that variations with age in the use of the auxiliary verbs are of little importance. There is an increased use of "be," "have," "shall," and "will" as auxiliaries by older children, undoubtedly to form participial phrases and perfect and future tenses. It is in the number of regular verbs used that development is found. There were in all 323 different regular verbs, and 140 irregular verb forms in addition to the auxiliary forms already discussed. (Each irregular form was listed separately--"see," "saw," "come,"

TABLE 4

USE OF THE MOST COMMON AUXILIARY VERBS BY CHILDREN AT THREE AGE LEVELS

Verb	Percentage of its Total Use Which is Auxiliary			Percentage of Total Auxiliary Verbs			Percentage of All Irregular Verbs		
	5½	6½	9½	5½	6½	9½	5½	6½	9½
be	28.0	29.5	42.9	37.0	33.8	40.5	33.7	36.8	29.5
do	65.3	62.3	67.6	18.8	17.7	8.7	7.3	7.6	3.9
have.....	21.1	19.4	24.4	4.9	6.1	6.1	6.0	8.6	7.7
can	85.3	86.1	90.4	13.0	10.4	12.8	3.8	3.2	4.4
go	37.3	38.0	34.2	11.6	10.1	9.6	8.0	7.0	8.7
got	2.6	3.1	5.1	0.6	0.6	0.4	5.2	5.1	2.4
will	100.0	100.0	100.0	11.8	17.1	16.6	3.0	4.5	5.5
shall ...	100.0	100.0	100.0	1.3	1.6	2.2	0.3	0.4	0.7

TABLE 5

PERCENTAGE DISTRIBUTION OF REGULAR AND IRREGULAR VERBS USED BY CHILDREN

Age	Sex	Type of Verb		
		Regular	Auxiliary	Other Irregular
		Total Verbs		
5½	Boys	14.8	21.2	64.0
5½	Girls	15.3	22.0	62.7
6½	Boys	20.6	21.1	58.3
6½	Girls	14.2	22.9	62.9
9½	Boys	20.1	23.8	56.1
9½	Girls	19.2	27.1	53.7
		Different Verbs		
5½	Boys	52.3	14.9	32.4
5½	Girls	51.7	15.0	33.3
6½	Boys	46.6	20.2	33.2
6½	Girls	45.4	20.3	34.3
9½	Boys	54.9	13.7	31.3
9½	Girls	53.4	13.1	33.4

"came.") The distribution of verbs according to number of different ones used as shown in Table 5 gives an idea of the great variety of regularly formed verbs employed.

Table 6 summarizes the actual occurrence in total speech of the most common everyday words. At each age the occurrence of forms of the verb "to be" approximately equalled that of the verbs "go," "do," "have," "got," "can," and "will" combined. The total occurrence of these common irregular verbs was about one-half that of the most common pronouns and modifiers and approximately 40 per cent of all the other common words listed. More than 50 per cent of the total speech of these children was composed of the words in this table. That is, all the remaining irregular verbs, all regular verbs, all other pronouns, modifiers, and connectives, all nouns, and all interjections barely equal in total frequency the occurrence of the words listed in Table 6. Such is language!

Another partially successful attempt at isolating age and sex differences was made by grouping certain words according to their central meaning, irrespective of grammatical usage. Thus, the writer suspected that the brighter children had a tendency to use expressions referring to the higher mental processes, such as "think," "wonder," "suppose," "know." The critical ratio between total number of "thinking" words per child at 5-1/2 years and at 9-1/2

TABLE 6

PERCENTAGE DISTRIBUTION OF MOST COMMON WORDS IN TOTAL SPEECH OF CHILDREN

Type of Word	Word	Age in Years		
		5½	6½	9½
Forms of common irregular verbs	be	7.5	8.1	6.4
	go	1.8	1.5	1.8
	do	1.6	1.7	0.8
	have	1.3	1.9	1.6
	got	1.1	1.1	0.5
	can	0.8	0.7	0.9
	will	0.7	1.0	1.2
Total verb forms		14.8	16.0	13.2
Forms of personal pronouns	first person	3.4	4.1	2.2
	third person	6.5	7.0	9.2
Modifiers				
Articles	a, an, the	6.3	6.4	7.3
Demonstratives	this, that, these those, here, there	8.1	9.6	9.1
Numerals	one	1.9	2.1	1.2
Total Pronouns and modifiers		26.2	29.2	29.0
Connectives				
Conjunctions	and	1.5	2.0	3.5
Prepositions	to	1.9	2.0	2.9
	of	1.1	1.2	1.1
	in	0.8	1.1	1.2
	up	1.2	1.1	0.6
	on	0.8	0.6	0.8
Total connectives		7.3	8.0	10.1
All words in this list		48.3	53.2	52.3

TABLE 7

CORRELATION BETWEEN NUMBER OF "THINKING" AND "SENSORY" WORDS AND IQ

Age in Years	"Thinking" Words	"Sensory" Words
5½	.21 ± .04	.18 ± .04
6½	.25 ± .07	.05 ± .08
9½	.27 ± .06	.07 ± .06

years was 3.21. At each age there was a slight positive correlation (Pearson product-moment method) between the number of such expressions and intelligence. A relationship of about the same magnitude had been found between total words used and intelligence. Although only a little more than one per cent of the total words used at each age were "thinking" words, there was a very slight increase with advancing age. This change is more noticeable when the percentage is calculated on the basis of different words used. Boys used a greater variety of such words than girls.

A similar list of words, the central theme of which is the primary sensory functions of sight and hearing, showed little relationship with development, although there was a suggestion that the percentage might be higher in girls than in boys. The correlations with intelligence (Table 7) were approximately zero except at 5-1/2 years.

Finally, all words referring to large-muscle movements (action words) were

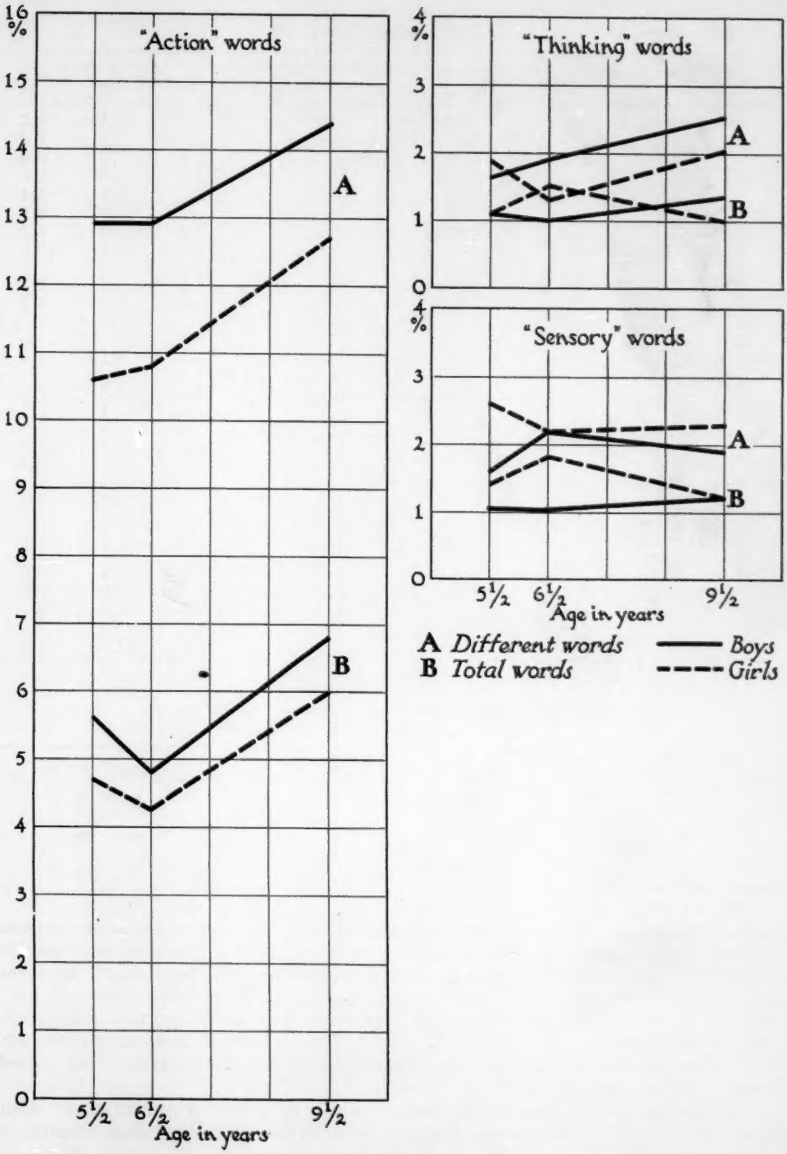

Fig. 2. Percentage distribution of "action," "thinking," and "sensory" words for boys and for girls at various ages.

TABLE 8

PERCENTAGE DISTRIBUTION OF "THINKING," "SENSORY," AND "ACTION" WORDS USED BY CHILDREN

Age in Years	Percentage in Total Speech Boys	Girls	Percentage of Different Words Boys	Girls
	"Thinking" Words			
5½	1.06	1.10	1.63	1.86
6½	1.00	1.54	1.87	1.34
9½	1.37	1.00	2.51	2.05
	"Sensory" Words			
5½	1.07	1.38	1.63	2.65
6½	1.07	1.82	2.16	2.14
9½	1.26	1.22	1.93	2.25
	"Action" Words			
5½	5.62	4.74	12.94	10.62
6½	4.79	4.26	12.95	10.83
9½	6.82	6.04	14.41	12.71

listed. The percentage of such words shows a clear-cut sex difference in favor of boys and a definite increase with advancing age. Table 8 and Figure 2 show the findings for "thinking," "sensory," and "action" words.

SUMMARY

1. The percentage distribution of the various parts of speech in children's language, based on total words used, is practically unchanged between the ages of 3-1/2 and 9-1/2 years.

2. Percentages based on number of different words used show a slight increase with age in number of nouns and regular verbs, but a decrease in pronouns, conjunctions, and prepositions.

3. With advancing age, children use a higher percentage of nouns naming human beings, but a slightly lower percentage of nouns naming animals. The percentage of nouns naming objects and abstract and collective terms does not change with age when the percentage is based on total words. When it is based on different words, there is a decrease in names of objects but an increase in abstract and collective nouns.

4. Age differences in the use of the different auxiliary and other irregular verbs are very slight.

5. Since age and sex variations in the percentage distribution of parts of speech are not of sufficient magnitude to change the pattern described by previous investigators, a more promising field for future research will be found in word meaning and function than in the traditional classification by parts of speech.

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A STUDY OF THE DEVELOPMENT OF THE ABILITY TO CARRY A MELODY AT THE PRESCHOOL LEVEL

ETHEL NATALIE DREXLER[1]

INTRODUCTION

The ability to carry a melody involves a coordination among many sensory and intellectual factors. To carry a melody accurately, the child must link the tones he hears with the tones he reproduces. In addition to possessing sensitivity to the kinesthetic action in his throat and diaphragm and the perception of the tones heard, he must remember the tunes and the individual phrases when attempting to reproduce them vocally. Hence, it is clear that the ability to carry a melody is very complex and far different from the immediate reproductions of tones or intervals. Previous studies in the preschool field have been largely confined to the analysis of the separate functions involved in singing, rather than to the use of these separate functions in singing a melody. Because the child is learning to carry a melody, one must be careful, in judging his performances in singing, to distinguish between quality based on aesthetic standards, and ability to follow a given melodic sequence. The latter process is of primary interest in the present study. After the child has mastered the rudiments, one may look for finer differentiations between the gifted musician and the one who sings merely for the amusement of himself and his intimates.

REVIEW OF THE LITERATURE

The past experimental literature on the singing ability of preschool children may be divided into three groups:

1. Intervals sung most easily. The first study was made by Werner (9) (cited by Stern), who analyzed the spontaneous song creations of children between two and five years. He claimed that the fundamental form of the childish tune is the minor third in descending order. The descending order is the earliest, since "the main energy of the melodic discharge is displayed to begin with, and a deeper tone is automatically produced with the diminished power of expiration."

Vance and Grandprey (11) in 1931 also concluded that the descending intervals are sung more accurately and more often by preschool children. In the same year, Jersild and Bienstock (5), from an extensive study of tonal intervals, concluded that the narrower intervals, namely seconds and thirds, are sung most easily and most frequently in descending order by preschool children. Especially interesting was the demonstration that children with specific training improved their initial performance in singing intervals, and that the children not so trained remained at their original status. In a follow-up study published in 1934 (6), the same authors found that after a lapse of two years the children who had received training retained their superiority over the control group. Other subjects used in the 1934 study substantiated the earlier findings, namely that narrower intervals were sung more readily than wider intervals, but that after a period of training these differences tended to disappear. Williams (12) in his study of 1933 also concluded that wider intervals are more difficult for the preschool child to sing than are narrower intervals.

The intervals used in the present investigation were almost exclusively seconds and thirds. An attempt was made to compose the songs so that the differences in singing ascending and descending intervals might be clearly observed.

[1]From the Institute of Child Welfare, University of Minnesota.

2. Pitch level and pitch range. The earliest study in this connection was done by Gutzmann (1) in 1909. He found that 75 per cent of his subjects, who ranged in age from birth to 6 years, sang notes ranging from F to A at the age of one to two years, from E to A at the age of three to five years, and from D to A at the age of six years.

No further study was made on this topic until 1931, when Jersild and Bienstock (5) published the findings of their research. They found that notes from middle C to A were sung most readily by their subjects. These findings clearly indicate that children's voices are placed lower than was commonly supposed. After a period of training this initial range was extended to include notes from middle C to F above C an octave higher. The authors conclude that children achieve the ability to sing a wider range of tones at a comparatively early age if they are so trained.

In 1933, Hattwick (2) made a survey of pitch range and pitch level in the singing of preschool children. He concluded that the mean pitch level used by children in singing voluntarily is significantly lower than the pitch levels for these same songs as printed in the song books. Hattwick further indicated that the mean pitch range of preschool children is 10.5 semi-tones extending from E to E#. Williams (12) in a study also published in 1933, states that the mean pitch range of the subjects that he used falls within the octave from middle C to C above.

In the experiment done by Jersild and Bienstock in 1934 (6), a more extensive sampling was used than in the previous studies. It was found that there is a definite increase in the number of notes sung by the children at the ages from 2 to 5 years, namely from five notes at two years of age to ten notes at five years.

The songs composed for this study attempted to place the range within the normal capacity of children at the preschool level, as indicated by the previous investigators. The two songs included a range of not more than one octave, beginning on middle C and extending to the C above.

3. Studies made on the ability to reproduce phrases. The experiments now to be cited are the most pertinent to the present study. The earliest investigation was carried out by Monroe (8) in 1903. His subjects were taught to sing the scale and a simple song. After a fortnight, the children were tested on their retention of both. It was found that in all cases the song was remembered better, and that there was a steady increase from the age of two to five years in this ability. Monroe offers as an explanation the fact that the children are particularly interested in the movement of a song and in the rhythm, and that they are influenced by associations made between the songs and concrete realities.

In 1933 Hissem (3) published the findings from a study of children from 21 to 59 months of age. It was found that only two of the subjects could successfully combine tones, and hence Hissem concluded that the nursery school songs usually taught to children are too difficult for actual reproduction. The present writer feels that these conclusions are too pessimistic. From the results to be cited now, it may be seen that not only are there a great number of children who can learn to sing a melody accurately, but also that this initial group may be extended by training.

Williams (12) in 1933 found that the immediate reproduction of three-note phrases was as easy to sing as the reproduction of single notes. He found that there was a definite increase in the ability to reproduce phrases with increase in age. In a later study by the same author (13) these earlier findings were substantiated.

We come finally to a discussion of the most recent study of preschool children's ability to sing, one done by Updegraff, Heiliger, and Learned (10). The subjects for this investigation were 66 children ranging in age from 3 to 6 years.

The subjects were arranged in matched groups at each age level. One of the groups was subjected to an intensive training program. After a period of 30 days it was found on the test of reproducing phrases that the three-and four-year-old experimental group doubled their initial scores and that the control group showed no marked improvement in performance. The authors conclude from their findings that the phrase test was the most discriminative test used in their investigation.

The present study, anticipating the increased ability at the older ages to reproduce the melodies, has been primarily concerned with devising an objective method of evaluating the performances of preschool children to carry a melody. In all of the previous studies, analyses were based on subjective evaluations of the experimenters. Since it was found that the most discriminating test of singing ability at the preschool level is the phrase test, an extension of this test was devised by the present writer for this study.

PURPOSES OF THE INVESTIGATION

1. To devise an objective method whereby the ability of the preschool child to carry a melody can be determined from analysis of records made on the Ediphone after a period of training.
2. To discover any age differences among preschool children in the ability to carry a melody, based on this method of evaluation.
3. To find the relationship between the children's home musical backgrounds as well as the abilities of the parents to sing, and the ability of the children to carry a melody.

PROCEDURE

Subjects:

1. Age.--The subjects used in this study were 14 Nursery School and 9 Kindergarten children, three to six years old, who were enrolled in the Nursery School and Kindergarten of the Institute of Child Welfare of the University of Minnesota. The median age was four years and five months. There were seven children between the ages of three and four years, seven children between the ages of four and five years, and nine children between the ages of five and six years. The median age in the three- to four-year-old group was three years and five months; in the four- to five-year-old group, four years and six months, and in the five- to six-year-old group, the median age was five years and three months.

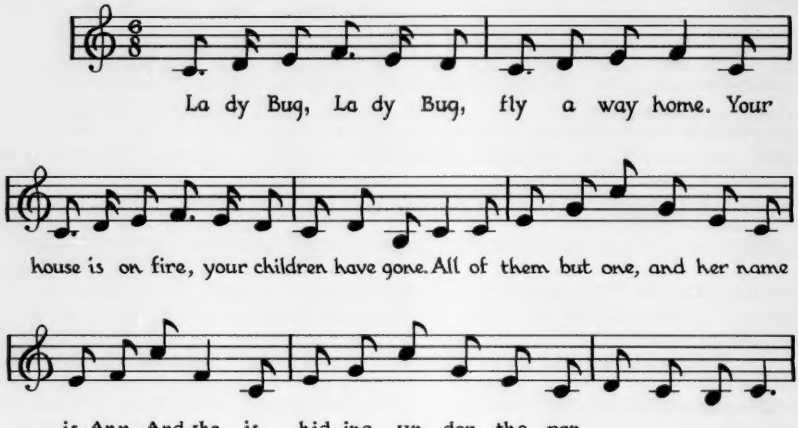
2. Intelligence.--The intelligence quotients of the subjects, as measured by the New Stanford Binet tests, ranged from 105 to 156, the mean being 123. The IQ's were obtained from tests given to the children within one year of the experiment, by trained mental testers of the University of Minnesota.

3. Socio-economic level.--As measured by the Minnesota Occupational Scale, fifteen of the subjects came from the Professional Group, or Group I; six subjects came from the Managerial Group, or Group II, and two subjects came from the Skilled Tradesmen Group, or Group III. The group may be considered as a homogeneous one from the upper socio-economic level.

Method:

1. Songs used.--In order to control the factor of unequal exposure to melodies, the experimenter chose two nursery rhymes which were familiar to all of the subjects, but which had never been presented to them in the form of songs. Both of the rhymes were of equal length, and of the same meter. For

Lady Bug


La dy Bug, La dy Bug, fly a way home. Your
house is on fire, your children have gone. All of them but one, and her name
is Ann. And she is hid ing un der the pan.

Old Woman in the Shoe

There was an old wo man who lived in a shoe. She
had so many children she didn't know what to do. She gave them some broth with-
out a ny bread. She told them a sto ry and put them to bed.

each of these rhymes the experimenter wrote simple melodies. Each of the songs was composed in the key of C major, using 6/8 time, and consisting of eight measures. An attempt was made to keep the two songs as nearly alike as possible in structure and difficulty. Ascending and descending intervals of seconds and thirds predominated, but intervals of fourths and fifths were occasionally introduced.

2. Training period.--The children in each of the schools were assembled in two separate groups for fifteen-minute periods on three alternate days, during which time the words of the songs were taught to them without musical accompaniment. The following week and for four successive weeks the children were taught the melodies to the rhymes, again during fifteen-minute periods on alternate days. Piano accompaniment was used in teaching the song "Lady Bug," and no instrumental accompaniment was used in teaching the song "Old Woman." Each of the training periods was led by the experimenter.

3. Surroundings.--In each case, the training period was held in the regular music rooms of both schools, during the regular music period, and conducted in the same manner as the regular music periods. The children were all well acquainted with the experimenter. The regular teachers were present during the training periods. The room in which the testing was done was familiar to the children. These factors were carefully controlled so as to insure adequate rapport and feelings of ease in the children.

4. Subjects chosen for the experimental group.--Of the original group of fourteen Kindergarten and twenty-six Nursery School children, those selected for the final experimental groups were the fourteen children in the Nursery School who had attended at least nine out of the possible fifteen training periods, and the nine children of the Kindergarten who had attended at least eight of the fifteen training periods. Further training was discontinued, since it was felt by the teachers and the experimenter that after the fifteenth training period each of the children who qualified for the experimental group had reached his optimum performance on the songs. These estimations were based on careful past observations of the children's abilities to sing other songs taught to them during the course of the regular music periods.

5. Testing periods.--The following week the experimenter demonstrated to each child how the Ediphone operated by first singing into the machine herself and then allowing the children to hear the record. In each case the child wished to sing into the machine himself, and was allowed to do so. On this initial trial the child was allowed to sing the songs in the order that he wished. In almost every case, and on the subsequent two trials, "Lady Bug" was the song chosen to be sung first. Although it will be seen that this song was the more difficult of the two, its popularity was probably based on the fact that it was the song taught to the children with piano accompaniment, as well as the fact that it contained a greater variability in tonal pattern.

On the following two alternate days, each child was again asked to sing into the Ediphone. Thus, each of the twenty-three subjects made in all three recordings of both songs. It must be mentioned here that in addition to allowing the children to sing either song first, they were also permitted to start the songs on any note that they chose, being checked by the experimenter only in cases where the notes were obviously too high or too low. In no case was the child prompted by the experimenter in singing; the only help that was given was for the experimenter to speak the words when the child hesitated. Hence, all recordings were made by the children unaided by either instrumental or vocal accompaniment.

6. Records.--After all of the records had been made, the experimenter transcribed the second trial of each song on to specially devised graphs. The model of these graphs will be found later in this report. The third trial of each subject was then transcribed by the experimenter twice, after a period of

one week had elapsed between the first and second transcriptions of these third trials. These transcriptions were not compared during the process.

In addition to the experimenter's transcriptions, three other persons were asked to transcribe the records. In these cases only the third trial was used, since it was found that there was little discrepancy between the two trials (coefficient of correlation between the second and third trials for "Lady Bug" and "Old Woman" were .86 and .89 respectively). One of these individuals had "absolute pitch" and the other two had "relative pitch." Each of the transcribers worked independently. In all, then, 276 transcriptions were made, 138 by the experimenter, and 46 by each of the three others.

In addition to the quantitative analysis made of these 276 transcriptions, that is by counting the number of notes which deviated from the original pattern, each of the transcriptions were ranked from a qualitative point of view, based on the inspection of the graphs by the experimenter.

7. Questionnaires.--Questionnaires containing questions that were weighted and carefully analyzed were sent to the parents and teachers of the subjects. These questionnaires aimed to obtain the teachers' and parents' estimations of the children's abilities to carry melodies and information concerning the home musical backgrounds of the children.

8. Ediphone.--The Ediphone used in this investigation was fitted with a special diaphragm, designed to sensitize the records to voices of young children. The Ediphone used as a means of recording the singing of preschool children had been found to be quite adequate by both Hattwick and Williams. Hattwick (2) says of this recording instrument: "It is an excellent motivating device to use with young children. It is economical both of time and expense. It is simple to operate. It will reliably record pitch changes in singing if properly monitored." A further advantage of this device, as found in the present study, is that the records may be played over many times, enabling the transcribers to check their results. The records may be kept for a considerable length of time without losing their original impressions.

9. Graphs.--The graphic method of transcribing the songs serves as an excellent means of analyzing the reproductions both from the quantitative and qualitative points of view. By plotting the notes sung by the children on to the original patterns, it may be seen how closely the child approximates the original pattern of the song. Furthermore one can analyze the songs from the standpoint of the number of notes sung incorrectly, the number of intervals of all magnitudes sung, the course of these intervals, the reduction of intervals to smaller magnitudes, etc. In the graphs, the solid line represents the original pattern, and the dotted line superimposed on the solid line, represents the pattern of the song sung by the children. The squares running from top to bottom represent the notes in the scale, that is from below middle C to an octave above, in the songs used. The squares running from left to right represent the tonal progressions.

Validity of the Method

The two outside criteria that were used to demonstrate the validity of the method were the parents' and the teachers' estimations of the children's abilities to carry melodies. The coefficient of correlation between the parents' estimations and the evaluation by the experimenter of the children's abilities to carry melodies was .718 $\pm$ .018. These coefficients were obtained from the Spearman rank order method, then corrected to Pearsonian coefficients. That between the teachers' rankings and those obtained by the objective method was .707 $\pm$ .06. That between the parents' and the teachers' rankings was .64 $\pm$ .08. It is felt by the writer that these coefficients may have been spuriously affected by the fact that the possible range obtained from the questionnaires extended from 0 to 3, as compared with the range from 0 to 153 obtained from the graphic

method of evaluation. The latter method allows for finer differentiation of abilities. Another factor that may have affected the coefficients obtained is that the parents had no means of comparing their standards of what constituted accuracy of singing with the standards held by the other parents. Hence it is concluded that the coefficients of correlations may be considered to be of sufficiently high order to warrant the assumption that the method is a valid one.

A further device was used to establish a measure of validity of the method, namely by finding the coefficients of correlation existing between the qualitative and the quantitative analyses of the transcriptions. The coefficient of correlation between these two analyses was .95 ± .013 for the second trials and .963 ± .012 for the third trials.

Reliability of the Method

The coefficient of correlation obtained between the second and third trials was .88 ± .03 for the song "Old Woman" and .86 ± .07 for the song "Lady Bug." The intercorrelations among the four independent transcribers were as follows:

TABLE 1

INTERCORRELATION ON SONG "LADY BUG"

Transcribers	1	2	3	4
1		.954 ± .01	.945 ± .016	.908 ± .023
2			.926 ± .022	.852 ± .04
3				.765 ± .058

TABLE 2

INTERCORRELATIONS ON SONG "OLD WOMAN"

Transcribers	1	2	3	4
1		.954 ± .01	.945 ± .016	.954 ± .01
2			.87 ± .036	.964 ± .01
3				.861 ± .03

The coefficient of correlation obtained between the songs "Lady Bug" and "Old Woman" on the third trial was .90 ± .02. The fact that in all tests of reliability the coefficients are of such high orders leads the writer to conclude that the method devised is a reliable one, yielding consistent results, and one which may be used by other investigators.

RESULTS

Since it was found that there was a close agreement between the second and third trials, the third trial alone will be used for all further analysis. The writer checked the two transcriptions she had made of the third trials, and found that the coefficient of correlation between them was .981 ± .003.

Graphs for one subject are presented to demonstrate the technique used in transcribing the Ediphone records. This particular graph shows the performance of one of the poorest singers. There were six subjects who sang the songs so accurately that the dotted lines indicating the children's performance coincided exactly with the solid line which indicates the original pattern.

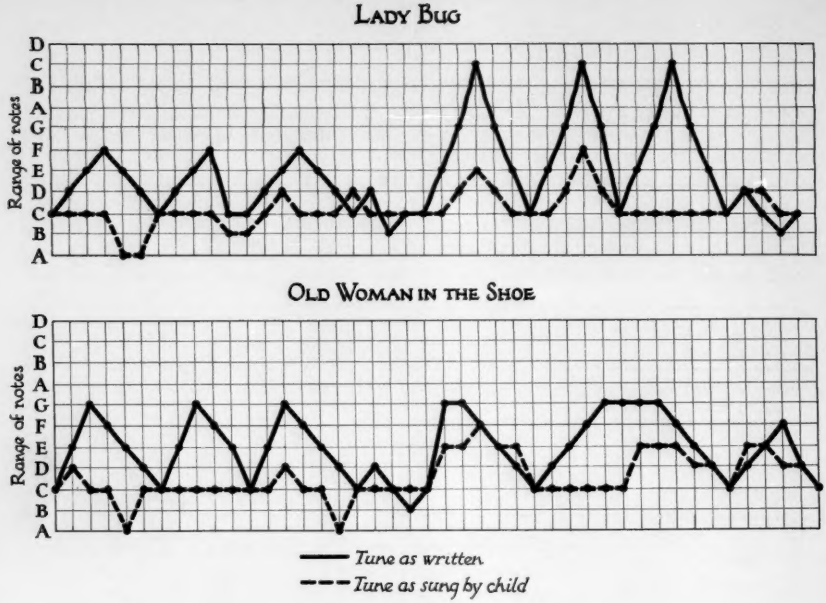


TABLE 3

NUMBER OF NOTES SUNG INCORRECTLY

Ages	Average +*	S.D.	Average -	S.D.	Both	S.D.
			Lady Bug			
3-4	9	4.24	41	17.8	50	22.74
4-5	12	14.66	23	23.19	35	31.79
5-6	2	5.66	11	16.16	15	20.64
			Old Woman			
3-4	21	25.05	20	20.95	41	22.87
4-5	6	6.78	22	23.32	28	24.12
5-6	2	3.16	8	14.31	10	17.15

	Critical Ratios		
	Lady Bug	Old Woman	Both
3-4 and 4-5	1.00	1.03	1.00
4-5 and 5-6	2.36	1.68	1.22
3-4 and 4-6	4.29	2.99	2.95

* + = Number of notes sung incorrectly above the original notes and the distance away from the correct notes that the substituted note was.
- = Number and distance below the original note that the substituted note was.

1. Accuracy in following the melodies.--Table 3 shows the analysis of the number of notes sung incorrectly by the subjects at the various age levels. As may be seen from the critical ratios, the differences that are most statistically significant are between the ages of three to four, and five to six years. The song "Lady Bug" was found to be more difficult for the children to sing, but the differences are slight. From an inspection of the averages at the age levels, it may be seen that the average number of incorrect notes decreases steadily as age increases. The standard deviations do not follow this trend to any marked degree.

TABLE 4

HOLDING SAME NOTE*

Ages	Lady Bug			Old Woman		
	Average Number Correct	Average Number Introduced	Total Possible Number Correct	Average Number Correct	Average Number Introduced	Total Possible Number Correct
3-4	1.14	16.29		2.14	16.57	
4-5	1.14	7.86		2.57	14.57	
5-6	1.71	3.22		3.33	3.44	
			2			4

Critical Ratios	
3-4 and 4-5	.39
4-5- and 5-6	1.48
3-4- and 5-6	2.18

*Average total number of notes sung, ages 3-4, 36.14, S.D. 16.40; ages 4-5, 24.14, S.D. 21.0; ages 5-6, 11.64, S.D. 8.29.

TABLE 5

ASCENDING AND DESCENDING INTERVALS OF SECONDS

Ages	Lady Bug			Old Woman		
	Average Number Correct	Average Number Introduced	Total Possible Number Correct	Average Number Correct	Average Number Introduced	Total Possible Number Correct
			Ascending			
3-4	4.14	3.85		2.42	2.28	
4-5	6.14	4.00		4.57	1.57	
5-6	12.42	3.00		7.11	0.44	
			13			9
			Descending			
3-4	2.00	4.85		7.42	4.29	
4-5	3.86	7.71		9.59	1.85	
5-6	5.66	2.11		16.55	.77	
			8			21

Critical Ratios*		
	Ascending	Descending
3-4 and 4-5	1.19	.63
4-5- and 5-6	1.18	.61
3-4- and 4-6	3.06	1.20

*Based on total number sung.

2. Analysis of intervals sung.--From an inspection of Table 4 it may be seen that the number of notes held decreases with age, showing that more distinctions have been made between the various notes at the older age levels, and also that progress is being made away from the monotone type of singing displayed more at the younger ages.

Table 5 demonstrates that the ascending intervals of seconds are more difficult than the descending intervals of seconds for the children to sing. These results are in keeping with those of previous investigators. The differences that are statistically significant are between the ages of three to four and five to six years, although the differences are more marked in the case of the ascending intervals. This fact indicates that the ability to sing ascending intervals is a measure of maturity in this function of singing. Both ascending and

TABLE 6

ASCENDING AND DESCENDING INTERVALS OF THIRDS

Ages	Lady Bug			Old Woman		
	Average Number Correct	Average Number Introduced	Total Possible Number Correct	Average Number Correct	Average Number Introduced	Total Possible Number Correct
			Ascending			
3-4	.86	1.86		2.00	2.00	
4-5	2.86	1.86		2.86	1.71	
5-6	3.88	.66		5.33	1.47	
			6			6
			Descending			
3-4	1.57	3.43		0.43	1.71	
4-5	2.57	0.85		0.85	2.00	
5-6	4.00	0.88		1.66	1.77	
			5			2

	Critical Ratios	
	Ascending	Descending
3-4 and 4-5	0.98	0.50
4-5- and 5-6	0.86	1.45
3-4- and 5-6	2.01	0.60

TABLE 7

ASCENDING AND DESCENDING INTERVALS OF FOURTHS AND FIFTHS

Ages	Lady Bug			Old Woman		
	Average Number Correct	Average Number Introduced	Total Possible Number Correct	Average Number Correct	Average Number Introduced	Total Possible Number Correct
			Ascending Fourths			
3-4	.29	0.00			.14	
4-5	1.28	.14			0.00	
5-6	1.66	.33			0.00	
			3			0
			Ascending Fifths			
3-4		.43		.43	.43	
4-5		.28		.57	0.00	
5-6		.11		.77	.11	
			0			1
			Descending Fourths			
3-4	.48	.14		0.00		
4-5	1.28	.14		.43		
5-6	1.77	.33		.44		
			3			0
			Descending Fifths			
3-4		0.00		.43	0.00	
4-5		.28		0.00	.14	
5-6		0.00		.22	0.00	
			0			1

descending intervals of seconds increase in number with increase in age, however.

From inspection of Table 6, it may be seen that the case is approximately the same in regard to ascending and descending intervals of thirds. However,

TABLE 8

NUMBER NOTES REDUCED TO HOLDING SAME NOTE

Age Levels	Reduced From Intervals of Seconds		Reduced From Intervals of Thirds	
	Lady Bug	Old Woman	Lady Bug	Old Woman
3-4	5.0	7.42	5.57	1.42
4-5	1.71	4.22	1.14	1.57
5-6	1.33	1.66	1.0	.44

TABLE 9

NUMBER INTERVALS OF SECONDS REDUCED FROM INTERVALS OF THIRDS

Age Levels	Lady Bug		Old Woman	
	Ascending	Descending	Ascending	Descending
3-4	1.71	1.0	.86	.43
4-5	.71	.57	.43	0.0
5-6	1.56	.78	.11	0.0

it may be noted that the critical ratios in all instances are less differentiating in these cases than they are in the case of the intervals of seconds. This fact leads the writer to conclude that intervals of thirds are easier at all ages to distinguish and produce than are the intervals of seconds.

Table 7 demonstrates that there is also an increase in the ability to sing intervals of fourths and fifths with increase in age. Again, the descending intervals are found to be easier for the children at all age levels to sing. These results, however, are not as clear as the foregoing, probably because the incidence of intervals of these magnitudes are considerably smaller.

Table 8 represents the number of notes which were reduced to holding the same note. It may be seen that this practice decreased as age increased, and that more of the subjects at all age levels reduced intervals of seconds to holding the same note than intervals of thirds. Again, this is an indication that there is a greater distinction made by the subjects between intervals of thirds than between intervals of seconds. The greatest progress in differentiating between intervals of seconds comes between the ages of three and four, and thereafter the increase in this ability is slight.

Table 9 shows the number of intervals of thirds that were reduced to intervals of seconds. It may be seen that, again, the older subjects resorted to this less frequently than did the younger children. Fewer of the descending intervals of thirds than of the ascending intervals were reduced to intervals of seconds.

3. Range.--It may be remembered that the children were allowed to start the songs on any note that they wished in order to insure the fact that they were singing within their normal ranges. The range of notes which were used to start the song "Lady Bug" extended from middle C to A above. The range of notes used to start the song "Old Woman" extended from middle C to A#. The majority of subjects sang within the range from middle C to D# in both songs. Considering the fact that the song "Lady Bug" had a range of one octave, it may be seen that the voices of the subjects used in this investigation were very flexible. In most cases, however, the children appeared to be most comfortable when they sang at lower pitch levels.

4. Parents' and children's abilities to sing.--The respective parents' judgments of their ability to carry melodies were weighted on the basis of a rating

TABLE 10

TOTAL NUMBER OF NOTES SUNG INCORRECTLY ACCORDING TO SEX

Ages	Girls			Boys			Critical Ratios between Girls and Boys
	Average +	Average -	Both	Average +	Average -	Both	
3-4	19	77	99	37	50	87	.49
4-5	19	50	49	22	30	52	.06
5-6	00.33	3	4	8	27	35	1.77

scale as well as on the length of time that they studied singing outside of the school curriculum. The coefficient of correlation between the mothers' and children's abilities to carry melodies was .618 ± .09, that between the fathers' abilities and that of the children was .37 ± .115. The fact that the relationship which existed between the abilities of the mothers and those of their children to sing was almost twice as great as that between the fathers' and children's abilities suggests strongly the importance of the role played by environment in the learning process of this function. The mothers supply most of the musical environment for their children, and thus the child learns from the examples of the mothers' singing. The correlation found between the fathers' and children's abilities to sing approximates closely the relationship usually found between inherited physical traits. However, these results must not be regarded as being predictive in general for cases beyond the scope of this study, since the number of subjects used was so small. The problem is one of importance and interest, and merits further research.

5. Analysis of home musical backgrounds.--The relationships which existed between the home musical background as measured by the type of music generally listened to in the home, the amount of time spent by the parents singing with the children, the amount of time spent by the children listening to the radio, piano, etc., and the abilities of the children to carry melodies, was found to be relatively low, namely, a coefficient of correlation of .32 ± .14. Undoubtedly the chief factor that influenced this low coefficient is the homogeneity of the home backgrounds. No extensive research has been made of the problem, although it seems that the results would be very interesting.

6. IQ and CA in relation to ability to carry a melody.--The coefficient of correlation found between the children's abilities to carry melodies and their IQ's was .37 ± .14. Although this coefficient is relatively small, it is greater than that obtained by McGinnis (7) who measured the separate abilities involved in singing as found by the Seashore Tests. She found a coefficient of correlation of .25 between IQ and the separate abilities involved in singing. The fact that correlations obtained in this study are twelve points greater indicates that the ability to carry a melody at this age level involves higher mental processes than those involved in utilizing the component parts of singing.

The coefficient of correlation between the CA (chronological age) and ability to carry a melody, as would be expected, was higher, being .59 ± .08.

7. Sex differences.--The distribution of sexes at the different age levels was approximately equal. From an inspection of Table 10 it may be seen that no marked sex differences were observed, except possibly at the age level of five to six years. Here it may be noted that the girls were slightly superior to the boys. However, the cases included in this study were so few in number that no general predictions can be made from the results here obtained.

SUMMARY

1. The reliability of the method is shown by an average intercorrelation of .91 among the four independent transcribers, and by correlations of .87 between the second and the third trial and .91 between the third trials of each song.

2. The validity of the method is shown by a correlation of .72 between the evaluation of the children's ability to carry a melody and that of their parents; of .71 between the authors' and the teachers' evaluation of the same ability; of .95 between the qualitative and the quantitative analyses of this ability.

3. There is a definite increase with age in the ability to carry a melody.

4. The difference in the ability to carry a melody is most significant between the ages of three to four and five to six years.

5. The closer intervals in descending order are easier for small children to sing accurately than the ascending intervals.

6. A closer relationship exists between the abilities of the mothers and those of their children to carry a melody than between the abilities of the fathers and those of their children.

7. The correlation between the IQ and ability to carry a melody is .37.

8. The correlation between the CA and ability to carry a melody is .59.

9. There are no significant sex differences observable in any of the factors analyzed in this investigation.

CONCLUSION

Although one must expect great individual differences to be found in any study of special abilities, it has been shown that with increase in age in the average child there is an increase in the ability to carry a melody. It has been suggested that children who are exposed to richer musical environments show a greater and earlier ability to carry a melody than those children whose musical environments are poorer. In addition, the previous studies cited have shown that, by a specific training program, the initial abilities to sing may be much improved. Jersild and Bienstock (6) have shown that this improvement is a relatively permanent one. Jersild (4) has also found that of all the abilities that respond most to training, the ability to sing is the one which shows most striking results. It may be expected that through a program of instruction based on scientific findings designed specially for preschool children, much may be hoped for in the way of enabling many more young children to sing accurately and to make the most of their musical potentialities.

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